equal parts of glycerin and alcohol.

3 specimens for control. = 4 cuts.

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Descriptive Anatomy

OF THE

Human Teeth

FIFTH EDITION

BY

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PREFACE TO THE FIRST EDITION.

BY my experience as a practitioner, as a teacher, and in my intercourse with fellow-practitioners, I have become convinced of a serious defect in the teaching of the details of the anatomy of the teeth, and in the systematization of the terms used in their description. This defect has been a constant drawback at the chair, in the laboratory, and most of all, in the college. The object of the present volume is to remedy, in a measure, this defect. To this end I have had constantly in view the needs of the dental student and practitioner.

We have heretofore had excellent general descriptions in human and comparative dental anatomy; but these have dealt principally with the general forms of the dentitions of the mammalia and other orders of animate beings, rather than with specific descriptions of the forms of the various surfaces and surface markings, making up the sum of the forms of the individual teeth of man. Valuable as these works have been, they have left the acquirement of a knowledge of the details of the specific forms of the human teeth mostly to individual observation. By this means, many have attained to an excellent perception of the various forms of the human teeth; but it is not reasonable to suppose the profession generally will do this without some fixed guide. What the dental student wants most in the college, and in the office, is a systematized nomenclature of the several parts of the teeth in detail; and such a description as will call his attention successively to every part of each tooth, as Gray, in his Anatomy, has called attention to every part of each bone, however apparently unimportant. It should be remembered that anatomy is not to be learned from books alone, but also by bringing the parts to be studied into view, and closely examining them in connection with the

descriptions given. Anyone who may read the present volume without a reasonable number of human teeth of each denomination before him for examination and comparison, will be but partially benefited.

It has been my object to systematize the nomenclature most in vogue with the profession, whenever practical, rather than to introduce new terms. However, the reader will find a few new terms, and possibly a few old ones that are used differently from the former custom. The terms up and down, to indicate direction or parts of teeth, are abandoned, because of their ambiguity. In a few instances, new forms of old words have been used, especially to avoid the terms inner, outer, backward, forward, etc., which are so often misleading. The words mesial, distal, labial, buccal, lingual, etc., are used as adverbs of direction by adding *ly*, or the same thing is accomplished by the use of the preposition *to*. It is as easy to say of a cavity that it extends far beyond, beyond, to, nearly to, or to the gingival line, as to say it extends up or down, etc., and the meaning will not be mistaken; or to say that a cavity extends distally, or to the distal, or lingually, or to the lingual, instead of backward, or inward, either of which has different meanings in different situations. The best rule is to use no extraneous object in the designation of the parts of, or direction on, the surface of a tooth; but to confine the phraseology to the specific and well-defined terms applied to its several parts. The back part of a molar would not mean the same relative part as the back part of an incisor. In many such ways the author has endeavored to systematize, and make more definite, the phraseology applied to the teeth without going to extremes, knowing well that forms of language once in use can be improved more easily than they can be displaced by new terms, though more exact.

The absence of a Bibliography may be noted. The plan and object of this work has not seemed to call for many references to authorities. This does not imply, however, that authors who have preceded me, as Fox, Carabelli, Tomes,

Wedl, Judd, Wortman, and many others, to whom we are greatly indebted, have been either overlooked or ignored.

The illustrations have all been made by the author for the purpose of illustration, rather than as works of Art. After experimenting with the various plans of the management of light and shade, diffused light has been used because more detail could be shown, especially in the difficult task of illustrating the occlusal surfaces of the teeth. Each picture of a tooth, in all its details, is drawn from accurate measurements of the particular tooth in hand.

Much of dental histology might properly find place in this book; but that subject is well represented by others. Malforms of the teeth, supernumerary teeth, and variations of arrangement, belong to the subject of irregularities, which is amply treated by several authors. My aim has been to confine the book strictly to normal macroscopic anatomy. However, a very serious difficulty, which has always met the dental anatomist, has been the variations of form in teeth of the same denomination. The endeavor has been to systematize these under one, two or more typical forms of each tooth, or its lobes, and point to the character of the changes which occur. This has occasionally led to the mention of abnormal forms.

The reader will find scattered through the work some hints with regard to the practical bearing of anatomical points on operative procedures, which, it is hoped, will be of value.

PREFACE TO THE SECOND EDITION.

THE rapid sale of the first edition of this work has shown an appreciation of a need for a more complete anatomical description of the human teeth. In preparing the work for a second edition, the aim has been to render the original design more complete in its details, and to make such verbal alterations as would better fit it for the text-book for the college, and for reference by the practitioner. The most notable changes are in the section on nomenclature; and these are confined to additional explanations of words and phrases. For the convenience of students a brief glossary has been added.

A number of the illustrations have been redrawn, and one has been added. Some of the numbers of the illustrations have been changed to render them consecutive; but the numbering of the paragraphs remains unchanged. Important words, especially the subjects of paragraphs and technical words the first time used, have been printed in bold-faced type. This, it is hoped, will be of advantage to the student and especially convenient for reference.

Valuable aid in the preparation of the work for reissue has been rendered by Mr. I. W. Davenport, Drs. D. M. Cattell, Edmund Noyes, and C. N. Johnson.

G. V. B.

JACKSONVILLE, ILL., July 15th, 1891.

PREFACE TO THE THIRD EDITION.

THE continued favor with which this work is received by the profession has made another edition necessary. In preparing this the endeavor has been to improve the detail without changing the form. The principal changes will be found in the nomenclature. The steady progress of dental nomenclature toward more exact forms demands this. It must now be recognized that we have two distinct forms of dental nomenclature, the one used in comparative dental anatomy, the other in human dental anatomy for the purposes of dentistry. The one is adapted to the description of the teeth of the various animals, including the teeth of man when his teeth are treated of in the comparative sense; the other is suited to the teeth of man when the more exact and detailed descriptions necessary to operative dentistry are presented. These word-forms necessarily become the basis of much of the nomenclature of operative dentistry. An extended examination of dental literature shows that up to a recent period, writers on operative dentistry had named more than twice as many points on the teeth than had writers on dental anatomy. This fact shows the necessity that had existed for the more extended and systematized presentation of the subject of dental anatomy, and the closer systematization of its nomenclature. However, the reader will find the changes introduced limited to one new word, *axial;* two new word-forms, *occlusal* in place of *occluding,* and *incisal* in compound forms, and the completion of the systematization of the names of the angles of the teeth. This latter has required but few word changes in the text.

Improvement has also been made in some of the descriptions, and a number of new illustrations have been added.

G. V. B.

JACKSONVILLE, ILL., August 21st, 1894.

PREFACE TO THE FOURTH EDITION

ON account of the exhaustion of the very large third edition of this work a fourth has become necessary. The teacher and the student will find but few changes. The author takes pride in referring to the very general approval of the work as a text-book, and to the fact that teachers who have used it in their classes since the first edition have so few changes to suggest.

The changes in this edition consist in the introduction of tables of the angles of teeth and the angles of surfaces of teeth, intended to aid the student in fixing these in his mind, and in the introduction of the word *embrasure* as an additional technical term.

Those openings between the angles of the teeth formed by the rounding of the proximate surfaces toward the buccal on the one side of the proximate contact and toward the lingual upon the other have never had a specific name, and the word *embrasure* has been introduced to supply this need in nomenclature. The word, when traced to its derivation, means an opening that widens, as in a wall, whether outward or inward. It has been most used in connection with defensive works; as "embrasures for cannon" in the walls of forts; though it frequently occurs in descriptions of other structures. The general progress of dental nomenclature toward exactness is very gratifying, and it is hoped that the addition of this word will be found advantageous.

G. V. B.

CHICAGO, October 9th, 1897.

GLOSSARY

Alveolus. (Pl. Alveoli.) A socket: The cavity in the process of the maxillary bone in which the root of a tooth is fixed.

Alveolar process. The projection of the maxillary bones which envelops the roots of the teeth and forms their alveoli.

Angle. The line, or point, where two or more surfaces of the teeth join. The mesial and buccal surfaces join in the formation of the mesio-buccal angle. (See Par. 7.)

Apex. The terminal end of the root of a tooth.

Apical foramen. The minute opening of the pulp canal at the apex of the root of a tooth. (See Par. 153.)

Apical space. The space between the bone, or wall of the alveolus, and the apex of the root of a tooth. This space is filled with the soft tissues of the peridental membrane, and is the seat of alveolar abscess.

Axial Angle. The line angles that are parallel with the long axes of the teeth are called axial angles. They are the mesio-buccal, and mesio-labial, disto-buccal, and disto-labial, mesio-lingual and disto-lingual angles.

Axial surfaces. Those surfaces of the teeth that are parallel with their long axes. They are labial, buccal, lingual, mesial, and distal surfaces.

Axial Walls. Of pulp chambers. Those walls that are parallel with the long axes of the teeth; the mesial, distal, buccal, and lingual walls.

Bell-Crowned. A tooth in which the mesio-distal diameter of the crown is much greater than that of the neck.

Bicuspid. A tooth with two cusps. They are also called premolars. There are eight bicuspids; two on each side of the upper jaw, and two on either side of the lower jaw. They are named right and left upper first and second, and right and left lower first and second bicuspids. They are situated between the cuspids and molars.

Border of the alveolar process. The thin edge of the alveolar process surrounding the necks of the teeth.

Buccal. Pertaining to the cheek. Toward the cheek.

Buccal surface. The surface of a tooth next to the cheek.

Buccal-gingival ridge. A prominent ridge near the gingival line on the buccal surface of the deciduous molars. It is especially prominent on the first deciduous molars.

Buccal-lingual. From the cheek toward the tongue; as the bucco-lingual diameter of the crown of a lower first molar.

Canal. See Root Canal.

Cementum. A tissue resembling bone which forms the outer surface of the roots of the teeth.

Contact point. The point on the proximate surface of a tooth which touches a neighboring tooth.

Crown. That portion of a tooth which is covered with enamel, and which projects from the tissues in which the root is fixed.

Cutting edge. The edge formed by the junction of the labial and lingual surfaces of the incisor and cuspid teeth. In the cuspids the edge is raised to a point near its center.

Cusp. A pronounced elevation, or point, on the surface of a tooth, more especially on the occlusal surface.

Cuspid. A tooth with one point, or cusp. There are four cuspids: one on either side in each jaw, situated at the corners of the mouth.

Deciduous teeth. The teeth of the child which are shed to give place to the permanent teeth. They are also called temporary teeth.

Dentine. The tissue of which the main body of a tooth is formed.

Developmental grooves. Fine depressed lines in the enamel of a tooth which mark the junction of its lobes. (See Pars. 21 and 69.)

Developmental lines. See developmental grooves.

Distal. Away from the median line of the face following the curve of the dental arch. The surface of a tooth most distant from the median line. (See Par. 5.)

Distally. A direction away from the median line of the face following the curve of the dental arch.

Distal angle. A contraction of disto-incisal angle. Used, also, instead of disto-bucco-occlusal angle (*q. v.*).

Disto-buccal angle. The angle formed by the union of the distal and buccal surfaces of the bicuspids and molars.

Disto-bucco-occlusal angle. The angle or corner of a bicuspid or molar tooth formed by the junction of the angles of its distal, buccal, and occlusal surfaces at a point.

Disto-incisal angle. The angle or corner of an incisor or cuspid tooth formed by the junction of the distal surface and cutting edge, or incisal surface.

Disto-labial angle. The angle formed by the union of the distal and labial surfaces of the incisors and cuspids.

Disto-lingual angle. The angle formed by the union of the distal and lingual surfaces of any of the teeth.

Disto-linguo-occlusal angle. The angle or corner of a bicuspid or molar tooth formed by the junction of the angles of its distal, lingual, and occlusal surfaces at a point. Rarely used.

Disto-occlusal angle. The angle formed by the union of the distal and occlusal surfaces of the bicuspids and molars.

Embrasure. An opening that widens outward or inward; as an opening in a wall for cannon. That portion of the inter-proximate space that widens toward the buccal or labial, or toward the lingual.

Enamel. A very hard tissue covering the crown of a tooth.

Fissure. A fault in the surface of a tooth caused by the imperfect joining of the enamel of the different lobes. Fissures occur along the lines of the developmental grooves.

Fossa. (Pl. Fossæ.) A round or angular depression in the surface of a tooth. Fossæ occur mostly in the occlusal surfaces of the molars, and in the lingual surfaces of the incisors

Gingiva. (Pl. Gingivæ.) The portion of gum tissue enveloping the necks of the teeth crown-wise from the attachment at the gingival line. The free margin of the gum.

Gingival. Pertaining to the gingival line; as the curvature of the gingival line, gingival margin, etc.

Gingival curvature. The deviation of the gingival line from the horizontal in its course around the neck of a tooth.

Gingival line. The line around the neck of a tooth at which the gingiva is attached. The line of junction of the enamel and cementum.

Gingival margin. The portion of the crown of a tooth next to the gingival line.

Gingivally. A direction from any part of the crown toward the gingival line of the tooth.

Groove. A long-shaped depression in the surface of a tooth. (See Par. 11.)

Horn. A slender, or blunt pointed process of the pulp of a tooth extending toward the point of a cusp.

Incisal. The cutting edges of the incisors and cuspids are regarded as incisal surfaces.

Incisal margin. That margin of a surface of an incisor or a cuspid tooth formed by the incisal surface or cutting edge; as the incisal margin of the labial surface of the central incisor.

Incisor. A tooth with a cutting edge. There are four incisors in the upper jaw, and four in the lower jaw. They are called the upper and lower right and left central, and the upper and lower right and left lateral, incisors.

Inclination. Of a tooth: The deviation of the long axis of a tooth from the perpendicular line; as the mesial inclination

of the incisors. (See Par. 191.) Of a surface: The deviation of a portion of the surface of a tooth from the general plane of that surface.

Incline. See Inclination.

Inter-proximate embrasure. That portion of the inter-proximate space which widens toward the buccal or labial, or toward the lingual. (See Par. 194.)

Inter-proximate space. The **V**-shaped space bounded by the proximate surfaces of adjoining teeth, and the border of the septum of the alveolar process between their necks. Normally this space is filled with gum tissue. (See Par. 193.)

Labial. Pertaining to the lips. Toward the lips.

Labial surface. The surface of a tooth next to the lips. The incisors and cuspids have labial surfaces.

Labially. A direction toward the lips.

Labio-lingual. From the lips toward the tongue; as the labio-lingual diameter of the central incisor.

Labio-lingually. A direction from the lips toward the tongue.

Line angles. Of the teeth: Those angles formed by the junction of two surfaces along a line; as the mesio-buccal angle, disto-buccal angle, etc.

Lingual. Next to, or toward the tongue; as lingual surface.

Lingually. A direction toward the tongue.

Lingual surface. A surface of a tooth next to the tongue. All of the teeth have lingual surfaces.

Linguo-gingival fissure. A fissure occurring occasionally in the lingual surface of the upper incisors. It usually separates the lingual lobe from one of the marginal ridges and extends into the cementum. (See Fig. 10.)

Linguo-gingival ridge. A ridge near the gum on the lingual surface of the incisors and cuspids. It is on the lingual lobe. (See Par. 21.)

Lobe. A division of a tooth formed from a separate point of the beginning of calcification. (See Pars. 21 and 69.)

Mammelons. The three rounded prominences seen on the cutting edges of the incisors when they first come through the gums. (E. Magitot.)

Marginal ridge. The ridges, or elevations of enamel on the margins of the occlusal surface of the bicuspids and molars, and on the mesial and distal margins of the lingual surface of the incisors and cuspids.

Median line. The antero-posterior perpendicular central line of the body.

Mesial. Toward the median line. Those surfaces of the teeth which, as they stand in the arch, and following its curve, are toward the median line, are called mesial surfaces.

Mesial angle. A contraction of mesio-incisal angle, also of mesio-bucco-occlusal angle (*q. v.*).

Mesially. Toward the median line.

Mesio-buccal angle. The angle formed by the union of the mesial and buccal surfaces of the bicuspids and molars.

Mesio-bucco-occlusal angle. The angle or corner formed by the junction at a point of the angles of the mesial, buccal, and occlusal surfaces of the bicuspids and molars.

Mesio-distal. From mesial to distal; as, the mesio-distal diameter of the lower first molar.

Mesio-incisal angle. The angle or corner formed by the junction of the mesial surface and cutting edge, or incisal surface, in the incisors and cuspids.

Mesio-labial angle. The angle formed by the union of the mesial and labial surfaces of the incisors and cuspids.

Mesio-lingual angle. The angle formed by the union of the mesial and lingual surfaces of the teeth.

Mesio-lingual groove. A developmental groove running from the mesial surface diagonally to the lingual surface in upper first molars that have the fifth cusp. (See Par. 69.)

Mesio-linguo-occlusal angle. The angle or corner formed by the junction of the angles of the mesial, lingual, and occlusal surfaces of the bicuspids and molars. Rarely used.

Mesio-occlusal angle. The angle formed by the union of the mesial and occlusal surfaces of the bicuspids and molars.

Neck. That portion of the tooth which forms the junction of the crown and root.

Oblique ridge. A ridge running obliquely across the occlusal surface of the upper molars. It is formed by the union of the triangular ridge of the disto-buccal cusp with the distal portion of the ridge forming the mesio-lingual cusp.

Occlude. To shut. To close.

Occlusal surface. That surface of a bicuspid or molar tooth that makes contact with a tooth of the opposite jaw when the mouth is closed.

Permanent teeth. The teeth of adult age as distinguished from the temporary, or deciduous teeth.

Pit. A sharp, pointed depression in the enamel. Pits occur mostly where several developmental grooves join; as in the occlusal surfaces of the molars, and at the endings of the buccal grooves on the buccal surfaces of the molars.

Point angles. Of the teeth: Those corners or angles formed by the junction of the angles of three surfaces at a point; as the disto-bucco-occlusal angle, the mesio-bucco-occlusal angle, etc.

Point of proximate contact. The point at which the proximate surface of a tooth touches the proximate surface of a neighboring tooth.

Proximate contact. The contact, or touching, of the proximate surfaces of neighboring teeth.

Proximation. The near approach, or contact, of the proximate surfaces of neighboring teeth.

Proximate surface. The surface of a tooth which lies next to another tooth. (See Par. 5.)

Pulp. The soft tissue that fills the pulp chambers and root canals of the teeth.

Ridge. A long-shaped elevation on the surface of a tooth.

Root. That portion of the tooth that is fixed in the bony walls of the alveolus, or socket; and is covered with cementum.

Root canal. The opening through the center of the long axis of the root of a tooth from the crown to the apex.

Rugæ. A series of irregular ridges in the roof of the mouth.

Septum. (Pl. Septa.) A partition: That portion of the alveolar process which lies between the roots of the teeth separating their alveoli.

Succedaneous teeth. Those of the permanent teeth which succeed, or take the places of, the temporary teeth.

Sulcate groove. A groove following the bottom of a sulcus.

Sulcus. (Pl. Sulci.) A notable long-shaped depression in the surface of a tooth the inclines of which meet at an angle. A sulcus has a developmental groove at the junction of its inclines.

Supplemental groove. A shallow long-shaped depression in the surface of a tooth, generally with a smoothly rounded bottom. Supplemental grooves differ from developmental grooves in that they do not mark the junction of lobes.

Supplemental lobe. A lobe that does not belong to the typical form of the tooth; an additional lobe.

Supplemental ridge. A ridge on the surface of a tooth that does not belong to the typical form of the tooth; an additional ridge.

Temporary teeth. See deciduous teeth.

Thick-necked. A tooth in which the mesio-distal diameter of the neck is nearly equal to that of the crown. (See bell-crowned.)

Thirds. Division of a crown of a tooth; as to length, into occlusal, or incisal third, middle third, and gingival third; as to mesio-distal breadth, into mesial third, middle third, and distal third.

Transverse ridge. A ridge formed of two triangular ridges, which join to form a continuous ridge across the occlusal surface of a tooth.

Triangular ridge. A ridge running from the point of a cusp toward the central portion of the occlusal surface of a tooth.

Tubercle. A slight rounded elevation on the surface of a tooth. Tubercles occur frequently on the linguo-gingival ridge of the incisors, and occasionally upon various parts of other teeth. They are deviations from the typical tooth forms.

DENTAL ANATOMY.

NOMENCLATURE

1. **Man's food** is both animal and vegetable, and his teeth are so formed as to enable him to readily masticate either kind; therefore, his teeth differ from those of both the carnivorous and herbivorous animals, and form the type of the **omnivora.** They are formed for cutting, tearing, and comminuting many kinds of food. The **incisors,** situated anteriorly, have edges for cutting; the **cuspids** and **bicuspids,** at the angles of the mouth, have fairly sharp, though not very long, points or cusps, suited for tearing; while the **molars,** situated in the posterior part of the mouth, have broad, tuberculated surfaces, which serve well to grind or comminute the more solid masses. The forms of the teeth of man indicate a design that his food should be taken in rather small masses, considered from the standpoint of the habits of animals in general, and that it should be very thoroughly commingled with saliva before being passed to the stomach.

2. The adult has thirty-two teeth: four incisors, two cuspids, four bicuspids, and six molars in each jaw. Scientific men express the denomination and number of the teeth of the mammalia by formulæ, in which the denomination is represented by the initial letter, followed by a horizonal line, with the number of that kind of teeth on one side of the upper jaw written above the line, and the number in the lower jaw written below the line. The dental formula of man is written thus:

$$\text{I } \tfrac{2}{2} \text{ C } \tfrac{1}{1} \text{ B } \tfrac{2}{2} \text{ M } \tfrac{3}{3} = 32.$$

This formula is read thus: Incisors, two upper and two lower; cuspids, one upper and one lower; bicuspids, two upper and

two lower; molars, three upper and three lower; sixteen on one side. As the opposite side has the same, the full number is thirty-two. The teeth are composed of four tissues: **Enamel,** which covers the crown; **dentine,** which forms the body of both crown and root; **cementum,** which covers the root and joins with the enamel at the gingival line, or neck of the tooth; and **pulp tissue** which fills the central cavity of the dentine.

3. Each tooth presents for description certain characters common to all, such as crown, neck or gingival line, root, pulp-chamber, canal, and surfaces of crown and root. The **crown** of a tooth is that part which projects beyond the gum tissue, and is covered with enamel; while the **root,** covered with cementum, is that portion fixed in the bony process of the jaw, by which the whole tooth is held securely in position. The root of a tooth may be **single,** as in the incisors and cuspids; divided into **two roots** as in the lower molars; or into **three roots,** as in the upper molars; or into a greater number, as in exceptional examples. The root is divided into the **body,** or main portion; the **apex,** or terminal end of a root; and the **neck,** which marks the junction of the root with the crown. A tooth is also marked with a slight constriction at the neck, and by the junction of the enamel with the cementum. The latter, which forms a visible line encircling the tooth, is called the **gingival line.** It is so curved in its course as to present a convexity toward the crown on the proximate surfaces, to correspond with the line of the gum as it passes over the alveolar ridge from the labial to the lingual side of the arch. On the anterior teeth, it is also so curved in passing the labial and lingual surfaces as to present a concavity toward the crown. These are called the **curvatures** of the gingival line, or the **gingival curvature.** The neck of a tooth is common to all of the roots, whatever the number, for the point of division into two or more roots is always rootward from the neck.

4. The **crowns** of the incisors and cuspids present for examination four surfaces and an edge; and the crowns of the

bicuspids and molars, five surfaces. (Diagram A.) These surfaces are named according to their position and use. Those of the incisors and cuspids presenting toward the lips, are called **labial surfaces**; those of the bicuspids and molars presenting toward the cheek, **buccal surfaces**; all presenting toward the tongue, **lingual surfaces**; whether in the upper or the lower jaw.* Those surfaces which came in contact with the opposing teeth in closing the mouth are called **occlusal surfaces.** The surfaces of the bicuspids and molars are also called grinding surfaces.

5. The **surfaces** of the teeth that present toward, or lie against, adjoining teeth are called **proximate** or proximal, surfaces. The proximate surfaces are also more closely defined by the terms **mesial** and **distal.** These terms have special reference to the position of the surface relative to the central or the median line of the face. This line is drawn along, the suture uniting the superior maxillary bones, or perpendicularly through the center of the face and mouth, and passes between the central incisors of both the upper and lower jaws. Those proximate surfaces which, as they are placed in the arch, *and following its curve,* are toward the median line, are called **mesial surfaces**; and those most distant from the median line are called **distal surfaces.** The mesial surfaces of the central incisors, both upper and lower, proximate each other; but in all other cases a mesial surface proximates a distal. Also, a distal surface always proximates a mesial surface, except those of the third molars, upper and lower, which have no distal proximate teeth. The points at which the proximate surfaces touch each other as the teeth stand in the line of the arch, are called the points of **proximate contact,** or simply **contact points.**

For convenience in designating the different parts of the crowns of the teeth, they may be divided into **thirds,** in any

* Some authors use the term "palatine surfaces" for those of the upper jaw, and "lingual" for those of the lower. This seems unnecessary.

one of three directions: Inciso- or occluso-gingivally into incisal, or occlusal third, middle third, and gingival third, mesio-distally into the mesial third, middle third, and distal third; bucco-lingually into the buccal third, middle third, and lingual third.

Each of the five **surfaces** may be divided into thirds in either one of two directions. The labial, or buccal, and the lingual surfaces are divided inciso- or occluso-gingivally, into the incisal, or occlusal third, middle third, and gingival third; mesio-distally into the mesial third, middle third, and distal third. Mesial and distal surfaces are divided inciso- or occluso-gingivally into the incisal, or occlusal third, middle third, and gingival third; bucco-lingually, into the buccal third, middle third, and lingual third. The occlusal surfaces are divided mesio-distally into the mesial third, middle third, and distal third; bucco-lingually, into the buccal third, middle third, and lingual third. The cutting edges, or incisal surfaces of the incisors and cuspids, are divided mesio-distally only. These divisions are the mesial third, middle third, and distal third.

6. The incisors present a **cutting edge** by the junction of the labial and lingual surfaces along a line. In the cuspids, this joining of the surfaces to form an edge is raised to a point near the center of its length, forming a **cusp**, hence the term cuspid, a tooth with one point. The cutting edges of the incisors, and the occlusal surfaces of the bicuspids and molars, come in contact with the similar surfaces of the teeth of the opposing jaw when the mouth is closed, as in the act of biting. The incisors and cuspids of the upper jaw do not occlude exactly on the cutting edges or cusps, but generally just back of them; though for convenience, the term occlusal may be applied to them as if they did, though they will generally be called **cutting edges**, and the adjective form **incisal** will be used in all compound words. The occlusal surfaces of the bicuspids have two cusps, hence the term **bicuspid**, a tooth with two points; and the occlusal surfaces of the molars have four **cusps** and sometimes more.

7. The **angles** of the teeth are of two kinds: **Line angles** and **point angles**. The line angles are formed by the junction of two surfaces along a line. The point angles are formed by the junction of three surfaces forming a corner. The incisors and cuspids have four, and the bicuspids and molars have eight line angles. Angles are named by combining in a compound word the names of the surfaces which join to form the angle. The incisors and cuspids have **mesio-labial** angles, which extend from the cutting edge to the gingival line along the line of union of the mesial and labial surfaces. Also, **disto-labial** angles, **mesio-lingual** angles, and **disto-lingual** angles, formed similarly by the junction of the surfaces named in these compound words.

The bicuspids and molars have **mesio-buccal** angles, formed by the junction of the mesial and buccal surfaces along a line from the occlusal surface to the gingival line. Also, **disto-buccal** angles, **mesio-lingual** angles, and **disto-lingual** angles, all of which are formed in the same manner as the mesio-buccal. These are called the **axial line angles** because they are parallel with the long axes of the teeth.

The bicuspids and molars have also four occlusal line angles, which are, however, more generally called **marginal ridges**. The **mesio-occlusal** angles extend bucco-lingually along the line of junction of the mesial and occlusal surfaces. The **disto-occlusal** angles are similarly formed. The **bucco-occlusal** angles and the **linguo-occlusal** angles extend mesio-distally along the line of junction of the surfaces named in these compound words.

The **point angles** of the bicuspids and molars are four occlusal and four gingival. As these are formed by the junction of the angles of three surfaces forming a corner, their names are compounds of the names of the three uniting surfaces. The **mesio-bucco-occlusal** angles are formed by the junction of the angles of these three surfaces at a point. The **mesio-linguo-occlusal** angles, the **disto-bucco-occlusal** angles, and the **disto-linguo-occlusal** angles are formed in a

similar manner. These names of point angles are precisely the same for all of the bicuspids and molar teeth.

The incisors and cuspids have, on account of their wedge-like form, but two **incisal** point angles. These are the **mesio-incisal** and **disto-incisal** angles, which form the corners at the mesial and distal terminations of the incisal surface or cutting edge.

The **gingival** point angles represent the corners of the crowns of the teeth at their junction with the roots at the gingival line, or the gingival termination of the axial line angles; and are named precisely as the axial line angles, with the addition of the word **gingival.** Thus, the incisors and cuspids have **mesio-labio-gingival** angles, **mesio-linguo-gingival** angles, **disto-labio-gingival** angles, and **disto-linguo-gingival** angles. These angles are named in the same way for the bicuspids and molars, except that the word buccal is substituted for labial; thus, **mesio-bucco-gingival** angle, **disto-bucco-gingival** angle, the angles on the lingual being named as in the incisors. Up to the present time the gingival point angles have not been used in descriptions of the teeth, and are given here only for the sake of completeness.

When any individual surface of a tooth is considered alone it is regarded as having margins and angles of its own, or belonging to it. Each margin is designated by the name of the surface with which it is joined, except that toward the gingival line, which takes the name **gingival margin.** The buccal surface of a bicuspid or molar has a **gingival** margin, a **mesial** margin, a **distal** margin, and an **occlusal** margin. The labial surface of an incisor has a **gingival** margin, a **mesial** margin, a **distal** margin, and an **incisal** margin. The margins of the lingual surfaces of all of the teeth are named in precisely the same terms as those of their buccal or labial surfaces. Also, the margins of mesial and distal surfaces are named in the same terms. A mesial or distal surface of a bicuspid or molar has a

gingival margin, a **buccal** margin, a **lingual** margin, and an **occlusal** margin. The mesial and distal surfaces of the incisors and cuspids have, on account of their triangular form, only three margins: the **gingival, labial,** and **lingual.**

The **angles of a surface of a tooth** are named by combining the names of the margins joining to form the angle. Thus, the buccal surface of a molar has four angles, the **mesio-occlusal, disto-occlusal, mesio-gingival** and **disto-gingival** angles. All angles of the surfaces of the teeth are named on this plan. The mesial and distal surfaces of the incisors and cuspids having but three margins have but three angles: the **labio-gingival, linguo-gingival,** and **incisal** angles.* (The name incisal angle is an exception to the general rule for naming angles of surfaces.)

8. A **cusp** is a pronounced elevation, more or less pointed on the surface of a tooth, but more especially on the occlusal surface. A slight elevation is often called a **tubercle** as that frequently seen near the gum on the lingual surface of the upper incisors. These are generally deviations from th typical forms of the teeth.

9. Long-shaped elevations on the surfaces of teeth are called **ridges,** and are named according to their location or form; as buccal ridge, lingual ridge, and marginal ridge. The **marginal ridges** are those elevations of the enamel which form the margins of the occlusal surfaces of the bicuspids and molars, and the mesial and distal margins of the lingual surfaces of the incisors and cuspids. Those ridges which descend from the cusps of the molars and bicuspids toward the central part of the occlusal surfaces are called **triangular ridges.** They are so called because the typical form of the ridges is usually that

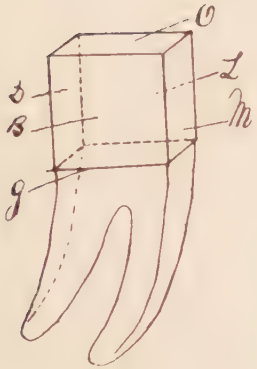
* The student should note carefully the difference between the names of the angles of a tooth and the angles of a surface of a tooth. To illustrate: The mesio-bucco-occlusal angle of a tooth is in effect the bucco-occlusal angle of its mesial surface, the mesio-buccal angle of its occlusal surface, or the mesio-occlusal angle of its buccal surface. In this work the descriptions are mostly of individual surfaces, hence the names of the angles of surfaces are much oftener used than the names of the angles of the teeth.

The following tables of the angles of teeth and the angles of surfaces of teeth, will assist the student in obtaining a clear understanding of them if studied in connection with the text and the illustrations.*

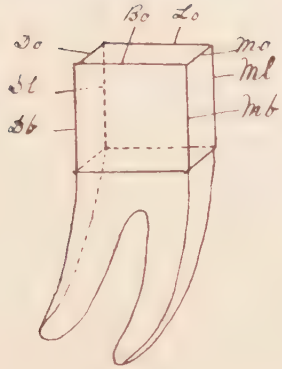
- **Angles of teeth**
  - Line angles
    - Incisors and cuspids
      - Mesio-labial
      - Disto-labial
      - Mesio-lingual
      - Disto-lingual
    - Bicuspids and molars
      - Mesio-buccal
      - Disto-buccal
      - Mesio-lingual
      - Disto-lingual
      - Mesio-occlusal
      - Disto-occlusal
      - Bucco-occlusal
      - Linguo-occlusal
  - Point angles
    - Incisors and cuspids
      - Mesio-incisal
      - Disto-incisal
    - Bicuspids and molars
      - Mesio-bucco-occlusal
      - Disto-bucco-occlusal
      - Mesio-linguo-occlusal
      - Disto-linguo-occlusal

- **Angles of the surfaces of teeth**
  - Incisors and cuspids
    - Labial and lingual surface angles
      - Mesio-incisal
      - Disto-incisal
      - Mesio-gingival
      - Disto-gingival
    - Mesial and distal surface angles
      - Labio-gingival
      - Linguo-gingival
      - Incisal
  - Bicuspids and molars
    - Buccal and lingual surface angles
      - Mesio-occlusal
      - Disto-occlusal
      - Mesio-gingival
      - Disto-gingival
    - Occlusal surface angles
      - Mesio-buccal
      - Disto-buccal
      - Mesio-lingual
      - Disto-lingual
    - Mesial and distal surface angles
      - Bucco-occlusal
      - Bucco-gingival
      - Linguo-occlusal
      - Linguo-gingival

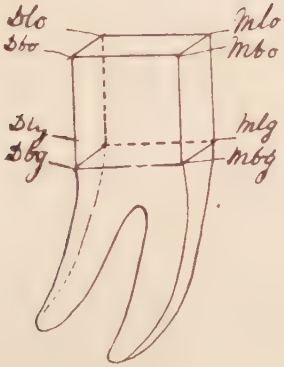
* Suggested by Dr. Wm. E. Harper.



A



B



C

NOTE.—In the naming of the surfaces and angles of the teeth the crowns are regarded as representing cubes with the angles more or less rounded, though they are named as if they were true cubes. For this reason the diagrams here given for the explanation of these names are drawn as cubes.

DIAGRAM A (Pars. 4 and 5).—THE SURFACES OF A LOWER MOLAR. *m*, Mesial surface; *l*, lingual surface; *b*, buccal surface; *d*, distal surface; *o*, occlusal surface; *g*, gingival line. This line passes entirely around the tooth at the junction of the crown with the root.

DIAGRAM B (Par. 7).—THE NAMES AND POSITIONS OF THE LINE ANGLES OF A MOLAR. *mb*, Mesio-buccal angle; *ml*, mesio-lingual angle; *db*, disto-buccal angle; *dl*, disto-lingual angle; *mo*, mesio-occlusal angle; *do*, disto-occlusal angle; *bo*, bucco-occlusal angle; *lo*, linguo-occlusal angle. The names of the occlusal line angles (the last four) are seldom used, as they are called also marginal ridges.

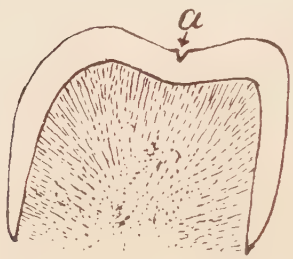
DIAGRAM C (Par. 7).—THE NAMES AND POSITIONS OF THE POINT ANGLES OF THE TEETH. It will be noticed that these angles are formed by the junction of three surfaces forming a corner or point, and that the names of three surfaces form the name of the angle. *mbo*, Mesio-buccal-occlusal angle; *mlo*, mesio-lingual-occlusal angle; *dbo*, disto-buccal-occlusal angle; *dlo*, disto-linguo-occlusal angle; *mbg*, mesio-bucco-gingival angle; *mlg*, mesio-linguo-gingival angle; *dbg*, disto-bucco-gingival angle; *dlg*, disto-linguo-gingival angle.

of a triangle. They are named after the cusps to which they belong, as the triangular ridge of the mesio-buccal cusp of the upper first molar, or simply, mesio-buccal triangular ridge. When a buccal and a lingual triangular ridge join they form a **transverse ridge.** In this way they often subdivide the central fossa of the lower molars and form supplemental fossæ.

10. A generally rounded or angular depression on the surface of a tooth is called a **fossa.** Fossæ occur mostly on the occlusal surfaces of the molars. When a notable depression is long-shaped it is called a **sulcus.** Some of these pass mesio-distally entirely through the occlusal surface of a tooth, as in the bicuspids. This term is often erroneously applied to the grooves and fissures.

11. A shallow, long-shaped depression, in the form of a line, on the surface of a tooth, is called a **groove.** When such a groove follows the bottom of a sulcus it is said to be **sulcate.** When such a groove sinks suddenly into the substance of a tooth in the form of a **fault** it is called a **fissure.** The words sulcus, groove, and fissure are often used as if they were synonymous and interchangeable, which has given rise to much confusion. It is necessary that the distinctions made in their use in dental anatomy be well understood. A groove is a very fine line in the form of a slight, sharp depression on the surface of the tooth, as represented in section in Diagram D, at *a* in a section cut at the point where the mesial groove passes over the marginal ridge of a bicuspid. Diagram E, from a cross section of a bicuspid, very close to the occlusal surface grooves are shown at *a, a.* A very shallow depression with rounded bottom is also called a groove, as those seen on the labial surfaces of the incisors. A sulcate groove is one that follows a sulcus of notable depth, the inclines of which approach each other at an angle as represented in Diagram F, *a,* pointing out the groove, and *c,* the inclines of the surface of the tooth which form the sulcus. A fissure is always a fault in the enamel, a point where the margins of the plates of enamel fail to unite, as represented at *a,* in Diagram G. These are distinctions of importance, and

there should be no confusion in the use of the words by which we distinguish them. There are two varieties of grooves in the teeth, differing essentially in their nature and formation. One class mark the **lines** on which the parts of the enamel first formed separately, are afterward joined, and are called the essential or **developmental grooves**, or developmental lines.



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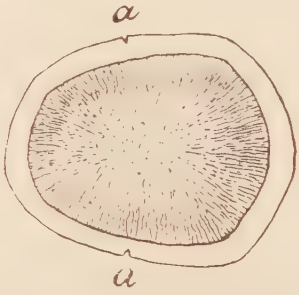

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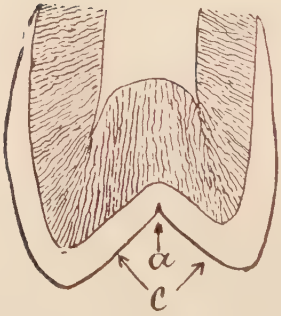
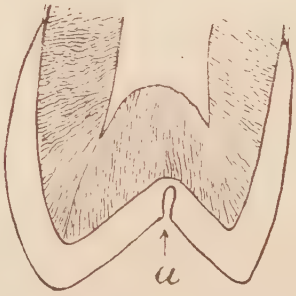


F



G

In their relation to the development of the enamel, they are of the same nature and resemble the sutures of the bones of the skull, which mark the junction of the separately formed plates. The parts, or divisions, of a tooth outlined by its developmental grooves are called its **lobes.** Most human teeth have four lobes; but some have five and some only three. Hence, these

grooves form the key to much of descriptive dental anatomy; and when they can be traced, enable the anatomist to unravel complex forms, and assign irregularly-formed teeth to the groups to which they belong, to properly name their individual parts, and identify any additional, accidental, or unusual forms of parts that may have become intermingled in the accident of a faulty formation. These developmental grooves, or lines, are subject to **fissures**, which occur when, from any cause, there is a failure of perfect union of the parts, leaving a **fault**.

12. The other class of grooves have no special relation to the developmental lines, and are called **supplemental grooves**. These are aptly described as wrinkles in the enamel, which, in fact, many of them are. But some are so constant in their location and form as to make up a portion of the typical tooth-form. The supplemental grooves are usually shallow, with well-rounded bottoms, and are not ordinarily subject to fissure.

13. In the **mesio-distal direction** all of the teeth are a little broader at or near their occlusal surfaces than at their necks; therefore, as they stand in the well-formed arch, their proximate surfaces touch only at or near the occlusal margins of their proximate surfaces, leaving **V**-shaped openings between their necks. These are called **inter-proximate spaces**. Normally, the inter-proximate spaces are filled with gum tissue.

In the **bucco-lingual direction** the proximate surfaces of the teeth are also more or less rounded, so that the proximate contact is narrowed to a point leaving a space widening toward the buccal and a space widening toward the lingual. These are called the buccal and lingual **inter-proximate embrasures**.

14. The teeth of different individuals show considerable variety of form. Some persons have teeth with very long crowns, broad in the mesio-distal direction at their occlusal surfaces and narrow at their necks. These present large inter-proximate spaces. They are known as **bell-crowned** teeth. Again, some individuals have teeth that, in their mesio-distal diameter, are nearly as thick at their necks as at the occlusal

surfaces, making their inter-proximate spaces very narrow, the teeth almost, or quite, touching along the whole length of the crown. These are known as **thick-necked** teeth. The more common form is midway between these two extremes. The teeth of some individuals and families have very long cusps; those of others have very short cusps. Some are deeply marked by grooves and sulci, and in those of others the grooves and sulci are shallow. Thus, there is considerable variety of contour without change of type.

MEASUREMENTS OF THE TEETH

15. In the following tables the results of the measurement of many teeth of each denomination are given. The numbers measured of the different varieties differed, but in all denominations they were sufficient to insure reasonable accuracy as to the average size. There are three measurements given, the average, greatest, and least, in the several positions measured. With a greater number, both larger and smaller teeth might be found, so that the tables must not be taken to represent the greatest nor the least that might be obtained; but the occurrence of larger, or longer teeth must be rare.

The lines of measurement are:

1st. "Length over all:" Length of the tooth from the cutting edge, or buccal cusp, to the apex of the root.

2d. "Length of crown:" Length of the crown from the cutting edge, or buccal cusp, to the gingival line on the labial or buccal surface.

3d. "Length of root:" Length of root from the gingival line on the buccal surface to the apex of the root.

4th. "Mesio-distal diameter of crown:" This is the extent from mesial to distal in the greatest diameter, or at the points of proximate contact.

5th. "Mesio-distal diameter of neck:" This measurement was made at the gingival line.

6th. "Labio- or bucco-lingual diameter:" This measurement was taken at the greatest diameter of the crown in the direction named. In the incisors it was on the gingival ridge. In the bicuspids and molars it was generally mid-length of the crown, but occasionally it was near the gingival line, especially in the upper second and third molars.

7th. "Curvature of the gingival line:" This is the height or extent of the curve of the gingival line toward the cutting edge, or occlusal surface, as it passes from labial to lingual, measured on the mesial surface.

Having these tables, the necessity for giving many measurements in the text is avoided.

UPPER TEETH.

Table of Measurements of the Teeth of Man, Given in Millimeters and Tenths of Millimeters.*		Length over all.	Length of crown.	Length of root.	Mesio-distal diameter of crown.	Mesio-distal diameter of neck	Labio- or bucco-lingual diameter.	Curvature of the gingival line.
UPPER TEETH.								
Central Incisor.	Average.	22.5	10.0	12.0	9.0	6.3	7.0	3.0
	Greatest.	27.0	12.0	16.0	10.0	7.0	8.0	4.0
	Least.	18.0	8.0	8.0	8.0	5.5	7.0	2.0
Lateral Incisor.	Average.	22.0	8.8	13.0	6.4	4.4	6.0	2.8
	Greatest.	26.0	10.5	16.0	7.0	5.0	7.0	4.0
	Least.	17.0	8.0	8.0	5.0	4.0	5.0	2.0
Cuspid.	Average.	26.5	9.5	17.3	7.6	5.2	8.0	2.5
	Greatest.	32.0	12.0	20.5	9.0	6.0	9.0	3.5
	Least.	20.0	8.0	11.0	7.0	4.0	7.0	1.0
First Bicuspid.	Average.	20.6	8.2	12.4	7.2	4.9	9.1	1.1
	Greatest.	22.5	9.0	14.0	8.0	6.0	10.0	2.0
	Least.	17.0	7.0	10.0	7.0	4.0	8.0	0.0
Second Bicuspid.	Average.	21.5	7.5	14.0	6.8	5.3	8.8	0.8
	Greatest.	27.0	9.0	19.0	8.0	6.5	10.0	1.5
	Least.	16.0	7.0	10.0	6.0	4.5	7.5	0.0
First Molar.	Average.	20.8	7.7	13.2	10.7	7.5	11.8	2.2
	Greatest.	24.0	9.0	16.0	12.0	8.0	12.0	3.0
	Least.	17.0	7.0	10.0	9.0	7.0	11.0	1.0
Second Molar.	Average.	20.0	7.2	13.0	9.2	6.7	11.5	1.6
	Greatest.	24.0	8.0	17.0	10.0	8.0	12.5	4.0
	Least.	16.0	6.0	9.0	7.0	6.0	10.0	0.0
Third Molar.	Average.	17.1	6.3	11.4	8.6	6.1	10.6	0.7
	Greatest.	22.0	8.0	15.0	11.0	8.0	14.5	2.5
	Least.	14.0	5.0	8.0	7.0	5.0	8.0	0.0

* There are 25.4 millimeters to the inch.

LOWER TEETH.

TABLE OF MEASUREMENTS OF THE TEETH OF MAN, GIVEN IN MILLIMETERS AND TENTHS OF MILLIMETERS.

		Length over all.	Length of crown.	Length of root.	Mesio distal diameter of crown	Mesio-distal diameter of neck	Labio- or bucco-lingual diameter.	Curvature of the gingival line
LOWER TEETH.								
Central Incisor.	Average.	20.7	8.8	11.8	5.4	3.5	6.0	2.5
	Greatest.	24.0	10.5	16.0	6.0	5.0	6.5	3.0
	Least.	16.0	7.0	9.0	5.0	2.5	5.5	1.5
Lateral Incisor.	Average.	21.1	9.6	12.7	5.9	3.8	6.4	2.5
	Greatest.	27.0	12.0	17.0	6.5	5.0	7.5	3.5
	Least.	18.0	7.0	11.0	5.0	3.0	6.0	2.0
Cuspid.	Average.	25.6	10.3	15.3	6.9	5.2	7.9	2.9
	Greatest.	32.5	12.0	21.0	9.0	7.0	10.0	4.0
	Least.	20.0	8.0	11.0	5.0	3.0	6.0	2.0
First Bicuspid.	Average.	21.6	7.8	14.0	6.9	4.7	7.7	0.8
	Greatest.	26.0	9.0	18.0	8.0	5.0	8.0	1.5
	Least.	18.0	6.5	11.0	6.0	4.5	7.0	0.5
Second Bicuspid.	Average.	22.3	7.9	14.4	7.1	4.8	8.0	0.6
	Greatest.	26.0	10.0	17.5	8.0	6.5	9.0	2.0
	Least.	18.0	6.0	11.5	6.5	4.0	7.0	0.0
First Molar.	Average.	21.0	7.7	13.2	11.2	8.5	10.3	1.1
	Greatest.	24.0	10.0	15.0	12.0	9.5	11.5	2.0
	Least.	18.0	7.0	11.0	11.0	7.5	10.0	0.0
Second Molar.	Average.	19.8	6.9	12.9	10.7	8.1	10.1	0.2
	Greatest.	22.0	8.0	14.0	11.0	8.5	10.5	1.0
	Least.	18.0	6.0	12.0	10.0	8.0	9.5	0.0
Third Molar.	Average.	18.5	6.7	11.8	10.7	8.3	9.8	0.2
	Greatest.	20.0	8.0	17.0	12.0	9.5	10.5	1.5
	Least.	16.0	6.0	8.0	8.0	5.0	9.0	0.0

UPPER AND LOWER TEETH.

TABLE OF MEASUREMENTS OF THE DECIDUOUS TEETH OF MAN, GIVEN IN MILLIMETERS AND TENTHS OF MILLIMETERS.

Averages Only.

	Length over all.	Length of crown.	Length of root.	Mesio-distal diameter of crown.	Mesio-distal diameter of neck.	Labio-lingual diameter of crown.	Labio-lingual diameter of neck.
UPPER TEETH.							
Central Incisor.	16.0	6.0	10.0	6.5	4.5	5.0	4.0
Lateral Incisor.	15.8	5.6	11.4	5.1	3.7	4.8	3.7
Cuspid.	19.0	6.5	13.5	7.0	5.1	7.0	5.5
First Molar.	15.2	5.1	10.0	7.3	5.2	8.5	6.9
Second Molar.	17.5	5.7	11.7	8.2	6.4	10.0	8.3
LOWER TEETH.							
Central Incisor.	14.0	5.0	9.0	4.2	3.0	4.0	3.5
Lateral Incisor.	15.0	5.2	10.0	4.1	3.0	4.0	3.5
Cuspid.	17.0	6.0	11.5	5.0	3.7	4.8	4.0
First Molar.	15.8	6.0	9.8	7.7	6.5	7.0	5.3
Second Molar.	18.8	5.5	11.3	9.9	7.2	8.7	6.4

UPPER TEETH.

Table of Measurements of the Teeth of Man, in Inches and Hundredths of an Inch.		Length over all.	Length of crown.	Length of root.	Mesio-distal diameter of crown	Mesio-distal diameter of neck.	Labio- or bucco-lingual diameter.	Curvature of the gingival line.
UPPER TEETH.								
Central Incisor.	Average.	.88	.39	.49	.35	.24	.27	.11
	Greatest.	1.06	.41	.63	.39	.27	.31	.15
	Least.	.72	.31	.31	.31	.21	.27	.07
Lateral Incisor.	Average.	.86	.34	.51	.25	.17	.23	.11
	Greatest.	1.02	.41	.63	.27	.19	.23	.15
	Least.	.66	.31	.31	.19	.15	.19	.07
Cuspid.	Average.	1.04	.37	.68	.29	.20	.31	.09
	Greatest.	1.26	.47	.80	.35	.23	.35	.18
	Least.	.79	.31	.43	.27	.15	.27	.03
First Bicuspid.	Average.	.81	.32	.48	.28	.19	.35	.04
	Greatest.	.89	.35	.55	.31	.23	.39	.07
	Least.	.66	.27	.39	.27	.15	.31	.00
Second Bicuspid.	Average.	.84	.29	.55	.26	.20	.34	.03
	Greatest.	1.06	.29	.55	.31	.25	.39	.05
	Least.	.62	.27	.39	.23	.17	.29	.00
First Molar.	Average.	.81	.30	.51	.42	.29	.46	.08
	Greatest.	.94	.35	.62	.47	.31	.47	.11
	Least.	.66	.27	.39	.35	.27	.43	.03
Second Molar.	Average.	.78	.28	.51	.36	.26	.45	.05
	Greatest.	.94	.31	.66	.39	.31	.49	.15
	Least.	.62	.23	.35	.27	.23	.39	.00
Third Molar.	Average.	.67	.24	.44	.33	.23	.41	.02
	Greatest.	.86	.31	.59	.43	.31	.57	.09
	Least.	.55	.19	.31	.27	.19	.31	.00

LOWER TEETH.

Table of Measurements of the Teeth of Man, in Inches and Hundredths of an Inch.		Length over all.	Length of crown.	Length of root.	Mesio-distal diameter of crown.	Mesio-distal diameter of neck.	Labio- or bucco-lingual diameter.	Curvature of the gingival line.
LOWER TEETH.								
Central Incisor.	Average.	.80	.34	.47	.22	.13	.23	.09
	Greatest.	.94	.41	.62	.23	.19	.26	.11
	Least.	.63	.27	.35	.19	.09	.21	.05
Lateral Incisor.	Average.	.83	.35	.50	.23	.15	.25	.09
	Greatest.	1.06	.46	.66	.26	.19	.29	.13
	Least.	.70	.27	.43	.19	.11	.25	.08
Cuspid.	Average.	1.01	.40	.60	.27	.20	.31	.11
	Greatest.	1.28	.46	.82	.35	.27	.39	.14
	Least.	.78	.32	.43	.23	.11	.24	.08
First Bicuspid.	Average.	.84	.30	.54	.27	.18	.30	.03
	Greatest.	1.02	.35	.70	.32	.20	.31	.05
	Least.	.71	.25	.43	.23	.16	.27	.01
Second Bicuspid.	Average.	.87	.31	.56	.28	.18	.31	.02
	Greatest.	1.02	.43	.63	.32	.25	.35	.07
	Least.	.71	.23	.45	.25	.15	.27	.00
First Molar.	Average.	.78	.30	.52	.33	.33	.40	.04
	Greatest.	.94	.39	.59	.37	.37	.45	.07
	Least.	.71	.27	.43	.28	.29	.39	.00
Second Molar.	Average.	.78	.27	.50	.42	.32	.39	.00
	Greatest.	.86	.31	.55	.43	.33	.41	.00
	Least.	.71	.23	.47	.39	.31	.37	.00
Third Molar.	Average.	.72	.26	.36	.42	.32	.38	.00
	Greatest.	.78	.32	.66	.47	.37	.41	.04
	Least.	.63	.23	.31	.31	.20	.35	.00

UPPER AND LOWER TEETH.

TABLE OF MEASUREMENTS OF THE DECIDUOUS TEETH OF MAN, GIVEN IN INCHES AND HUNDREDTHS OF AN INCH.

Averages Only.

	Length over all.	Length of crown.	Length of root.	Mesio-distal diameter of crown.	Mesio-distal diameter of neck.	Labio-lingual diameter of crown.	Labio-lingual diameter of neck.
UPPER TEETH.							
Central Incisor.	.63	.23	.39	.25	.18	.20	.16
Lateral Incisor.	.62	.25	.45	.20	.14	.19	.14
Cuspid.	.74	.25	.53	.27	.20	.27	.21
First Molar.	.59	.20	.39	.28	.20	.23	.27
Second Molar.	.68	.22	.46	.32	.25	.39	.32
LOWER TEETH.							
Central Incisor.	.55	.19	.35	.15	.11	.15	.13
Lateral Incisor.	.59	.19	.39	.15	.11	.15	.13
Cuspid.	.66	.23	.45	.19	.14	.17	.15
First Molar.	.62	.24	.38	.30	.25	.27	.21
Second Molar.	.62	.21	.44	.38	.28	.34	.25

UPPER CENTRAL INCISORS.

NOTE.—Usually, in the description of the teeth, those of one side only will be mentioned, without reference to which side in the text. Accompanying the illustrations, the side to which the tooth belongs will be given. The student will readily determine to which side a given example belongs by comparing it with the text and correctly naming its surfaces. Students should remember that the cuts are representations of individual teeth, while the text describes the average forms, therefore the cuts will not always exactly correspond with the text.

16. The right and left upper central incisors are situated in the extreme anterior part of the dental arch, one on each side of the median line, their mesial surfaces proximating each other. The **crown** presents four surfaces, four angles, and a cutting edge, or incisal surface. The general contour of the crown is similar to a wedge, with rounded angles, and merging into a rounded form at the thick end, or the neck of the tooth. It is slightly bent on its shorter diameter, so as to make the flattened labial surface convex; while the other, the lingual, is concave. The crown is also slightly bent in the mesio-distal direction, so that the labial surface is convex and the lingual concave in this direction. Therefore, there is a general convexity of the labial, and a general concavity of the lingual surface.

17. The **labial surface** of the crown of the upper central incisor (Fig. 1), in its general form, is an imperfect square, with its gingival side rounded. The mesial margin is a little longer than the distal, so that the cutting edge slopes away toward the disto-incisal angle (Fig. 1, *h*). Both the angles, formed by the proximate surfaces and cutting edge, are slightly rounded, the disto-incisal more than the mesio-incisal, after which the proximate surfaces converge toward the long axis of the tooth, making the crown a little narrower at the neck than at the cutting edge.

18. The **lingual surface** of the crown (Fig. 2) is concave in all directions, forming a **fossa**, bounded by the cutting edge (*a*), the mesial and distal marginal ridges (*n*, *m*), and the

Fig. 1.

Fig. 2.

Fig. 3.

Fig. 4.

Fig. 5.

Fig. 1* (Par. 17).—Right Upper Central Incisor, Labial Surface. *a*, Cutting edge; *b*, mesial surface; *c*, distal surface; *d*, labial surface; *e*, *e*, labial grooves; *g*, mesio incisal angle; *h*, disto-incisal angle; *i*, body of root; *k*, apex of root.

Fig 2* (Par. 18).—Right Upper Central Incisor, Lingual Surface. *a*, Cutting edge; *b*, mesial surface; *c*, distal surface; *d*, linguo-gingival ridge, or cingulum; *f*, gingival line; *g*, mesio-incisal angle; *h*, disto-incisal angle; *i*, body of root; *k*, apex of root; *m*, distal marginal ridge; *n*, mesial marginal ridge.

Fig. 3* (Par. 18).—Left Upper Central Incisor, Lingual Surface, showing lingual pit. The cutting edge, *a*, is considerably worn. The mesial and distal marginal ridges, *b*, *c*, are prominent; *d*, linguo-gingival ridge; *f*, gingival line; *g*, mesio-incisal angle; *h*, disto-incisal angle; *i*, body of root; *k*, apex of root; *m*, lingual pit.

Fig. 4* (Par. 19).—Right Upper Central Incisor, Mesial Surface. *a*, Mesio-incisal angle; *d*, linguo-gingival ridge; *f*, *f*, gingival line, showing its labio-lingual curvature; *i*, body of root; *k*, apex of root.

Fig. 5* (Par. 21).—Left Upper Central Incisor, Lingual Surface. Young, unworn tooth. The developmental lines, or grooves, are made diagrammatically prominent to show the form of the lobes. *a*, Middle lobe; *b*, mesial lobe; *c*, distal lobe; *d*, lingual lobe; *e*, *e*, linguo-gingival groove; *f*, *f*, lingual developmental grooves; *g*, mesio-incisal angle; *h*, disto-incisal angle.

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* Illustration 1½ diameters.

linguo-gingival ridge or cingulum (*d*). The **marginal ridges** are strong elevations of the enamel, running from the mesio-incisal and disto-incisal angles along the borders of this surface to near the gingival line, where they join the linguo-gingival ridge. The **linguo-gingival ridge** is a strong elevation of the enamel forming the linguo-gingival border of the crown. It is sometimes elevated into a tubercle. The lingual fossa is usually smooth, and the ridges by which it is bounded are not prominent. In many instances, however, there is a deep pit at the junction of the linguo-gingival ridge with the lingual surface proper; and in some a groove extends from the pit for a short distance along the border of each marginal ridge (Fig. 3). These latter may, or may not, be fissured. In a few examples the enamel of this surface has irregular wrinkles, or ridges and grooves, running from the linguo-gingival ridge toward the cutting edge. In malformed teeth this surface is often very imperfect.

19. The **mesial** and **distal** surfaces each present the outline of the letter **V**, with its lines curved with the convexity toward the lips, and the acute angle at the cutting edge (Fig. 4). The mesial surface is almost straight from the mesio-incisal angle to the gingival line. It is convex from labial to lingual, but nearly flat toward the gingival line; while in some there is even a slight concavity, centrally at, or near, the gingival line. In the labio-lingual direction, the distal surface is rounded, as in the mesial. In the majority of examples it is also convex in the direction of the long axis of the tooth, so that it bellies out toward the lateral incisor.

20. At the **gingival line**, the tooth is a little constricted, forming a slight furrow; or rather, the root at the neck is a little smaller than the crown, and the enamel slopes down to the size of the root, giving the appearance of a continuous ridge of enamel around the neck. This line does not run horizontally around the neck of the tooth. On the proximate sides it forms curves with the convexity toward the crown, that on the mesial being a little the greater, and on the labial and lin-

gual surfaces it forms a curve with the concavity toward the crown. This line marks the limit of the attachment of the peridental membrane and gum tissue to the root of the tooth.

21. **Developmental lines** (Fig. 5). When any of the incisors first appear through the gums there are three little eminences, or **tubercles**, called mammelons, on the cutting edge with **grooves** crossing from labial to lingual between them (*a, g, h*). These grooves run some distance on the labial surface, becoming broader and shallower till they disappear. In many, these lines appear on the lingual surface between the marginal ridges and the fossa (*f, f*). Occasionally, they are seen as far as the linguo-gingival ridge. The mammelons are soon removed from the edge by wear, leaving it straight, or slightly curved. These lines divide this part of the crown of the tooth into three **labial lobes.** Calcification begins in these mammelons as separate pieces, or plates, and the grooves are the marks of the after-confluence of these plates. This is common to the incisors and cuspids. These teeth are sometimes fissured across the cutting edge, marking an imperfect confluence of the primary plates. The calcification of the linguo-gingival ridge, or cingulum, is also begun as a separate plate, forming the **lingual lobe,** but afterward it becomes united to the other parts by confluence, leaving a groove, often very slight, indeed, and soon obliterated by wear, marking the line of union. This is the **linguo-gingival groove** (*e, e*). (This groove is properly three grooves corresponding with the mesial, central, and distal grooves of the bicuspids, while the linguo-gingival ridge corresponds to the lingual cusp. See Par. 41.) In smooth regularly formed teeth it begins at the gingival line just lingual of the summit of its labio-lingual curvature, and runs across the marginal ridge at right angles with its length, then runs almost horizontally across the lingual surface to the distal marginal ridge. This ridge is now crossed at right angles, and the gingival line reached. The length of the groove usually includes from a quarter to a third of the circumference of the tooth. When the linguo-gingival ridge is prominent, or rises

Fig. 6.

Fig. 7.

Fig. 8.

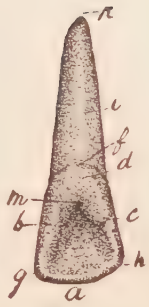

Fig. 9.

Fig. 10.

Fig. 11.

Fig. 6* (Par. 24).—Right Upper Lateral Incisor, Labial Surface. *a*, Cutting edge; *c*, distal surface; *e*, labial grooves; *f*, gingival line; *g*, mesio-incisal angle; *h*, disto-incisal angle.

Fig. 7* (Par. 25).—Right Upper Lateral Incisor, Mesial Surface. *a*, Mesio-incisal angle; *d*, linguo-gingival ridge; *f*, *f*, gingival line; *i*, body of root; *k*, apex of root.

Fig. 8* (Par. 26).—Right Upper Lateral Incisor, Lingual Surface, without lingual pit. *a*, Cutting edge; *b*, mesial marginal ridge; *c*, distal marginal ridge; *d*, linguo-gingival ridge; *f*, gingival line; *g*, mesio-incisal angle; *h*, disto-incisal angle; *i*, body of root; *k*, apex of root; *m*, lingual fossa.

Fig. 9* (Par. 26).—Right Upper Lateral Incisor, Lingual Surface, with lingual pit. *a*, Cutting edge; *b*, mesial marginal ridge; *c*, distal marginal ridge, with linguo-gingival groove crossing it; *d*, linguo-gingival ridge, or cingulum; *f*, gingival line; *g*, mesio-incisal angle; *h*, disto-incisal angle; *i*, body of root; *k*, apex of root; *m*, lingual pit.

Fig. 10* (Par. 26).—Right Upper Lateral Incisor, showing a linguo-gingival fissure. *a*, Cutting edge; *b*, linguo-gingival groove fissured; *f*, gingival line; *g*, mesio-incisal angle; *h*, disto-incisal angle.

Fig. 11* (Par. 27).—Upper Lateral Incisor, Mesial Surface. Very short root. *a*, Mesio-incisal angle; *d*, linguo-gingival ridge; *f*, gingival line.

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* Illustration, 1½ diameters.

in the form of a tubercle, this groove is subject to much variation in its course. Often, there is a deep pit in the center of its length; *i.e.*, centrally in the lingual surface, at the margin of the linguo-gingival ridge (Fig. 3, *m*). From this, fissures may extend laterally. Occasionally, especially in the lateral incisors, a sulcus, or a fissure divides the linguo-gingival ridge from one of the marginal ridges, and extends into the cementum (Fig. 10). This is the linguo-gingival fissure.

22. The **root** of the upper central incisor (Figs. 1 to 5) is about one and a fourth, to one and a half times as long as the crown. It is conical in form, tapering from the crown to the apex; less rapidly near the neck, and more rapidly as the apex is approached. Therefore, the body of the root seems a little swollen. However, the root of this tooth presents great variety of figure, as do the roots of teeth generally. The root is nearly round at the neck. The curvature of the lingual surface is the arc of a smaller circle than that of the labial. The proximate surfaces are slightly flattened. The flattened portion of the mesial surface is a little broader than the distal. These two converge to the lingual, giving the form of a prism with its angles rounded.

UPPER LATERAL INCISOR

23. The description of the lateral incisor may be much abridged, because of its resemblance to the central in its general form and developmental lines. The tooth is a little shorter, and from mesial to distal the crown is about a third narrower.

24. The **labial surface** of the lateral incisor (Fig. 6) is more rounded in the mesio-distal direction than in the central. The mesio-incisal angle is acute, and the cutting edge slopes away in a curve to a rounded and obtuse disto-incisal angle. The cutting edge, at the time of eruption, presents three tubercles, or mammelons, and the grooves crossing the edge between these are projected on the labial surface as shallow labial grooves.

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25. The **mesial** (Fig. 7) and **distal surfaces** present the characteristic **V**-shape of all the incisors. From labial to lingual the mesial surface is rounded near the cutting edge, but much flattened near the gingival line. Sometimes a slight concavity exists at this point. Occasionally the mesio-labial angle has a flattened or sunken point of enamel near the middle of its length. This is sometimes broad and of notable depth, and in this case is generally in the labial portion of the mesial surface. In others, it is a small imperfection in the mesial margin of the labial surface. The distal surface is convex in all directions. In its incisal third, it rounds out freely toward the cuspid, but becomes more flattened toward the gingival line.

26. The **lingual surface** (Fig. 8) of lateral incisors is very irregular in the extent of its concavity. Some are almost flat, while others are deeply concave. The mesial and distal marginal ridges are proportionately broader and stronger than in the centrals. In the majority of examples the lingual surface is the broadest part of the crown. The rounding of the proximate surfaces is at the expense of the labial surface, so that a moderately acute angle is formed by the junction of the proximate surfaces with the lingual. Generally, the lingual surface is almost smooth, but in many, a pit, with or without lateral fissures, will be found at the junction of the lingual surface proper, with the linguo-gingival ridge (Fig. 9). In some of these, the linguo-gingival ridge is unusually short, so that the marginal ridges are folded in together at their gingival ends, forming a deep sulcus between them, and there is a deep pit at their junction. Again, some are found in which there is a deep groove, which is often **fissured** dividing one marginal ridge from the linguo-gingival ridge, and extending into the cementum (Fig. 10). This is sometimes nearly central, giving the appearance of a failure of the lingual lobe, or of a divisor of the lobe centrally, or of the displacement of the lobe to one side. This is the linguo-gingival fissure.

27. The root of the upper lateral incisor (Figs. 6 to 11)

Fig. 12.

Fig. 13.

Fig. 14.

Fig. 15.

Fig. 16.

Fig. 17.

FIG. 12* (Par. 29).—LEFT LOWER CENTRAL INCISOR, LABIAL SURFACE. Long root. *a*, Cutting edge; *e*, labial grooves; *f*, gingival line; *g*, mesio-incisal angle; *h*, disto-incisal angle.

FIG. 13* (Par. 29).—LEFT LOWER LATERAL INCISOR, LABIAL SURFACE. Long root. *a*, Cutting edge; *e*, labial grooves; *f*, gingival line; *g*, mesio-incisal angle; *h*, disto-incisal angle; *i*, body of root; *k*, apex of root.

FIG. 14* (Par. 29).—RIGHT LOWER LATERAL INCISOR, LABIAL SURFACE. Short root. *a*, Cutting edge; *e*, labial grooves; *f*, gingival line; *g*, mesio-incisal angle; *h*, disto-incisal angle; *i*, body of root; *k*, apex of root.

FIG. 15* (Par. 30).—LOWER CENTRAL INCISOR, LINGUAL SURFACE. *a*, Cutting edge; *b*, mesial marginal ridge; *c*, distal marginal ridge; *d*, linguo-gingival ridge; *g*, mesio-incisal angle; *h*, disto-incisal angle; *m*, lingual ridge.

FIG. 16* (Par. 30).—LOWER CENTRAL INCISOR, DISTAL SURFACE. *a*, Cutting edge; the edge is worn away as represented by the line; *d*, linguo-gingival ridge; *f*, *f*, gingival line; *i*, groove along the distal side of root; *k*, apex of root.

FIG. 17* (Par. 31).—RIGHT LOWER LATERAL INCISOR, DISTAL SURFACE, showing root deeply grooved. *a*, Cutting edge; *d*, linguo-gingival ridge; *f*, gingival line; *i*, deep groove in root; *k*, apex of root.

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* Illustration, 1½ diameters.

is conical, but considerably flattened on its mesial and distal sides, which is generally maintained to the apex. The root is generally straight, and about one and a half times as long as the crown. In many specimens the apex is curved to the distal. Occasionally the root is very crooked.

28. The upper lateral incisor presents much variety of size and form. It is not uncommon to find narrow laterals associated with broad centrals. The lateral upper incisors are more often wanting, or imperfectly developed, than the other anterior teeth. In the latter, the crown of the tooth is frequently conical, with a rounded, or even a moderately sharp, point.

THE LOWER INCISORS.

29. The **lower incisors** have outlines similar to the upper lateral, but are, in every way, more slender. Their developmental lines are the same, but the grooves are much less marked, and generally cannot be seen except in unworn teeth. The cutting edge of the lower central (Fig. 12) is very nearly at right angles with the long axis of the tooth, and its mesio- and disto-incisal angles are square and sharp. From mesial to distal, the cutting edge is the widest part of the crown, and from it the proximate surfaces converge equally to the gingival line, reducing the mesio-distal diameter about a third. The lower lateral differs from the central by the cutting edge sloping away to the distal, the mesio-incisal angle being acute, and the disto-incisal angle obtuse and rounded. The distal surface is also convex from the disto-incisal angle to the gingival line, bellying out toward the cuspid.

30. The **lingual surface** (Fig. 15) of the lower incisors is concave from the cutting edge to the linguo-gingival ridge, over which there is a convexity (Fig. 16). Near the cutting edge this surface is generally nearly flat in the mesio-distal direction, but is sometimes concave or slightly convex; it becomes convex progressively toward the linguo-gingival ridge. In many there is a slight ridge on the center of this surface with a shallow concavity on either side, which marks the junction of

the lobes, running from near the cutting-edge to the linguo-gingival ridge (Fig. 15). The **mesial** and **distal surfaces** are convex near the cutting edges, but become flattened, and sometimes slightly concave, toward the gingival line.

31. The **roots** of the lower incisors are slender and much flattened in their mesio-distal diameter, and not unfrequently slightly grooved on the mesial and distal sides. While the flattening of the crown of the lower central is generally at right angles with the flattening of its root, the distal portion of the crown of the lower lateral is directed more to the lingual, so as to appear slightly twisted on its root in most examples. The labial surface of the crown and root, in its length, forms nearly the arc of a circle (Fig. 17), though the curve of the surface of the crown is usually a little greater than that of the root (Fig. 16). The lingual surface of the root is almost straight, but in the apical third it is convex, sloping away to form the apex. The roots of these teeth are generally straight, but occasionally the apex is curved to the distal.

THE CUSPIDS.

32. We have **four cuspids**, one on each side in the upper, and one on each side in the lower jaw. They are sometimes called canine teeth, or eye teeth. They are situated at the angles of the mouth, between the lateral incisors and the first bicuspids. They are third from the median line, and are large, and strong teeth of simple form, firmly implanted in the alveolar process by a long, strong root.

THE UPPER CUSPIDS.

33. The **labial surface** of the crown of the upper cuspid (Fig. 18) is a little narrower in the mesio-distal direction than in the central incisor, with nearly equal length from the point of the cusp to the gingival line. Instead of a straight, or only slightly curved cutting edge, as in the incisors, the central portion of the crown is extended into a well-formed point (*a*),

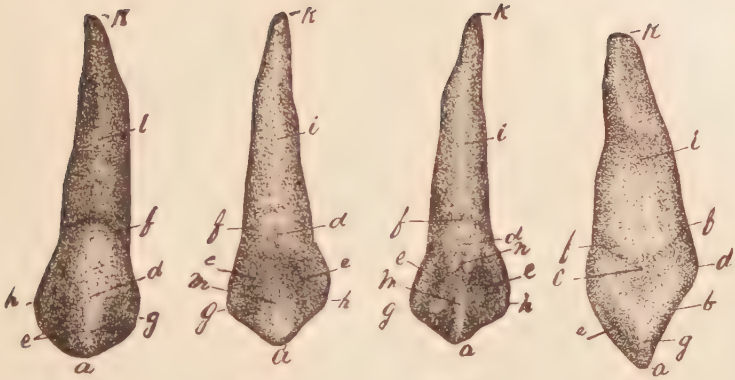

Fig. 18. Fig. 19. Fig. 20 Fig. 21.

Fig. 22. Fig. 23. Fig. 24.

Fig. 18* (Par. 33).—Right Upper Cuspid, Labial Surface. *a*, Point of cusp; *d*, labial ridge; *e*, labial grooves; *f*, gingival line; *g*, mesio-incisal angle; *h*, disto-incisal angle; *i*, body of root; *k*, apex of root.

Fig. 19* (Par. 34).—Right Upper Cuspid, Lingual Surface. The more common form. *a*, Point of cusp; *d*, linguo-gingival ridge; *e*, *e*, lingual grooves; *f*, gingival line; *g*, mesio-incisal angle; *h*, disto-incisal angle; *i*, body of root; *k*, apex of root; *m*, lingual ridge.

Fig. 20* (Par. 34).—Right Upper Cuspid, Lingual Surface of irregular form. *a*, Point of cusp; *d*, linguo-gingival ridge; *e*, *e*, lingual grooves; *f*, gingival line; *g*, mesio-incisal angle; *h*, disto-incisal angle; *m*, prominent lingual ridge; *n*, two small tubercles on linguo-gingival ridge.

Fig. 21* (Par. 35).—Right Upper Cuspid, Mesial Surface. *a*, Point of cusp; *b*, mesial marginal ridge; *c*, point of slight concavity of mesial surface; *d*, linguo-gingival ridge; *e*, labial groove; *f*, *f*, gingival line; *g*, mesio-incisal angle; *i*, body of root; *k*, apex of root.

Fig. 22* (Par. 37).—Left Upper Cuspid, with a very long and crooked root.

Fig. 23* (Par. 37).—Right Upper Cuspid, with a peculiarly crooked root.

Fig. 24* (Par. 37).—Left Upper Cuspid, with a very small and short root.

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* Illustration, 1½ diameters.

with cutting edges sloping away to the mesio-incisal and disto-incisal angles (*g*, *h*). Of these cutting edges, the distal is a little the longer, and from the disto-incisal angle to the gingival line, the distal surface is a little shorter than the mesial. In unworn teeth, the angle formed by the union of the cutting edges to form the cusp is usually about ninety degrees, or a square. The point is a little rounded at first, but is soon much rounded or flattened by wear. Both the mesial and distal margins of the labial surface of the crown, from the mesio- and disto-incisal angles to the gingival line, slope toward the central axis of the tooth—the distal slope being the greater. This narrows the crown at the neck nearly one third from the width of its widest point. The curvature of the gingival line on this surface, marking the termination of the crown, is about a quarter circle. The surface is convex in all directions, and is much more rounded in the mesio-distal direction than in the incisors. In the direction of its length, the convexity is about the same as in the incisors. The greater convexity mesio-distally is caused by a strong labial ridge (*d*) running from the point of the cusp to the gingival line. This ridge occupies so much of the surface of the tooth that its margins are imperfectly defined. It belongs to the middle lobe, developed from the middle plate, which, in the incisors, is the smallest of the three, but in this tooth is much the largest. There are two labial furrows (*e*), or a flattening of the convexity between the central line of the ridge and each angle, marking the junction of the lobes. These furrows are usually lost by becoming shallower before reaching the center of the length of the crown. In well-formed teeth, this surface presents a uniform enamel, free from pits or sulci.

34. The **lingual surface** (Fig. 19) presents the same general marginal configuration as the labial, though it is somewhat narrower toward the gingival line. This is caused by the arc of convexity of the lingual surface of the neck of the tooth being of a smaller circle than that of the labial, and by the flat-

tening of the proximate surfaces on lines which converge rapidly to the lingual. This surface is usually almost straight from the cusp to the linguo-gingival ridge, or cingulum, but is sometimes slightly concave. The **linguo-gingival ridge** is sharply convex and longer from the gingival line to the point of convexity than in the incisors. (Fig. 21, *d*.) Mesio-distally this surface is slightly convex in its central part on account of the lingual ridge which runs from the point of the cusp nearly, or quite, to the cingulum. On each side of this, and between it and the marginal ridges, there is a slight, but well-defined concavity and furrow, marking the confluence of the lobes. The **marginal ridges** arise from the mesio and disto-incisal angles and unite with the linguo-gingival ridge or cingulum. These ridges are usually large near the angles, and much less pronounced toward the linguo-gingival ridge. The latter is prominent, and is often raised into a tubercle, or slight cusp. Occasionally this part of the enamel is thrown into irregular folds, with grooves between, which are sometimes fissured. More rarely the small cusp may be divided by a groove (Fig. 20, *n*). The linguo-gingival groove is often pronounced in unworn teeth.

35. The **mesial surface,** near the incisal angle (Fig. 21), is convex in all directions, but becomes flattened, and occasionally slightly concave, near the gingival line (*c*).

36. The **distal surface** is similar to the mesial, but is more convex, usually being well rounded in the labio-lingual direction to the gingival line. But in the direction of the long axis of the tooth this surface, on account of its distal projection is first convex, and further toward the gingival line is concave, especially near and at the neck of the tooth. The labio-lingual curvature of the gingival line is about 2.5 m.m., varying from 1.0 m.m. to 3.5 m.m. on the mesial surface, and a little less on the distal.

37. The **root** of the upper cuspid is the longest in the human mouth, averaging, according to my measurements, 17.5

Fig. 25.

Fig. 26.

Fig. 27.

Fig. 28.

Fig. 29.

FIG. 25* (Par. 38).—LEFT LOWER CUSPID, LABIAL SURFACE. *a*, Point of cusp; *b*, mesial surface; *c*, distal surface; *d*, labial ridge; *e*, distal labial groove; *f*, gingival line; *g*, mesio-incisal angle; *h*, disto-incisal angle; *i*, body of root; *k*, apex of root.

FIG. 26* (Par. 38).—LEFT LOWER CUSPID, MESIAL SURFACE. *a*, Point of cusp; *d*, linguo-gingival ridge; *f*, gingival line; *g*, mesio-incisal angle; *i*, body of root, which is distinctly flattened; *k*, apex of root.

FIG. 27* (Par. 38).—LEFT LOWER CUSPID, DISTAL SURFACE. *a*, Point of cusp; *c*, labial groove; *d*, linguo-gingival ridge; *e*, concavity of the distal cutting edge where the groove passes over it; *f*, gingival line; *h*, disto-incisal angle; *i*, body of root; *k*, apex of root.

FIG. 28* (Par. 39).—LEFT LOWER CUSPID, LINGUAL SURFACE. *a*, Point of cusp; *d*, linguo-gingival ridge; *e*, lingual grooves; *f*, gingival line; *g*, mesio-incisal angle; *h*, disto-incisal angle; *i*, body of root; *k*, apex of root; *l*, distal marginal ridge; *m*, lingual or triangular ridge; *n*, mesial marginal ridge.

FIG. 29* (Par. 40).—RIGHT LOWER CUSPID, MESIAL SURFACE. *a*, Point of cusp; *d*, linguo-gingival ridge; *f*, gingival line; *g*, mesio-incisal angle. The root is short and thick.

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* Illustration, 1½ diameters.

m.m., and varying from 11.0 to 21.0 from the apex to the gingival line at the labial surface. It is irregularly conical in form, tapering from the neck to the apex. Its labio-lingual diameter is a little greater than its mesio-distal, which gives the root a flattened appearance, but it is seldom entirely flat on either the mesial or distal surface. In most examples the body of the root is straight, and tapers to a slender point, which is often curved to the labial and distal, though the form of this root presents great variations. Frequently, it is very crooked, perhaps, because, when it is taking its place in the arch, it is often crowded by the teeth mesial and distal to it, so that its growth in a right line is interrupted. (See Figs. 22, 23, and 24.)

THE LOWER CUSPIDS.

38. In their general figure, the lower cuspids so closely resemble the upper, a description of their differences will be sufficient. They are slightly smaller than the upper cuspids, and the crowns are a little longer, which make them appear more slender. The **mesial surface** of these teeth is usually nearly straight the entire length of the root and crown (Figs. 25 and 26); so that the increased width of the crown over the root is mainly on the distal. This causes a marked prominence of the disto-incisal angle. In many examples this gives the tooth the appearance of being bent, with a considerable concavity on the distal side in the cervical region. In young, unworn teeth, the cusp is rather more prominent and pointed than in the upper cuspid, and the distal cutting edge is proportionately longer; but, as the point of the cusp comes directly in occlusion with the upper teeth, it is soon worn to a blunt point, or a flat surface, inclining to the labial and sloping away to the distal.

39. The **lingual surface** (Fig. 28) is very smooth, and the ridges are less prominent than in the upper cuspid. A tubercle on the linguo-gingival ridge is rare. The developmental lines, or grooves, are the same as those of the upper

cuspids, but less prominent. Yet, generally, they can be seen in unworn teeth. Fissures are seldom seen in any part of this tooth.

40. The **root** of the lower cuspid (Figs. 25 to 29) is shorter than the upper, and generally more flattened in the mesio-distal diameter, often presenting deep furrows. In rare instances, there is a division of the root near the extremity. The root is nearly straight, and in many examples the lingual surface of the root is nearly a straight line, while the labial surface, root, and crown, present a nearly regular convexity. The root is not so often abnormally crooked as that of the upper cuspid, though, like the upper, it is much inclined to end in a slender apex, which is often slightly bent in the labial direction.

THE BICUSPIDS.

41. There are eight bicuspids, or premolars, two on each side in the upper jaw, and two on each side in the lower jaw. Hence they are called the **first** and **second** bicuspids. They are situated between the cuspids and first molars, and are the fourth and fifth teeth from the median line. The bicuspids, though unlike the incisors and cuspids in the contour of their crowns, have the same number, and a similar distribution of primary parts, or **lobes.** They are, indeed, formed on the same general plan. The change of form is the result of a different relative development of the parts, by which the cingulum, or linguo-gingival ridge, is elevated into a powerful **lingual cusp,** which, in the upper bicuspids, is almost or quite as high as the buccal cusp, but in the lower bicuspids, especially in the first, is less prominent. The middle lobe also forms a relatively larger part of the buccal portion of the crown than in the incisors and cuspids; while the mesial and distal lobes are relatively smaller. By the development of the lingual cusp of the upper bicuspids, the linguo-gingival grooves of the incisors and cuspids (*g.v.*21) are carried to the central part of the crown, which they traverse from mesial to distal in a deep sulcus (Fig. 30). It is naturally divided, by the mesial and distal pits

Fig. 30

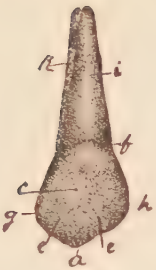

Fig. 31

Fig. 32.

Fig. 33

Fig. 34

Fig. 35

Fig. 30* (Par. 42).—Left Upper First Bicuspid, Occlusal Surface. *a*, Point of buccal cusp; *b*, lingual cusp; *c*, buccal ridge; *d*, mesial marginal ridge; *e*, distal marginal ridge; *f*, triangular ridge of the buccal cusp; *g*, disto-bucco-occlusal angle; *h*, mesio-buccal occlusal angle; *i*, triangular ridge of the lingual cusp; *l*, central groove; *o*, mesial groove; *p*, distal groove; *n*, *m*, triangular grooves; *r*, *s*, buccal grooves.

Fig. 31* (Par. 46).—Left Upper First Bicuspid, Buccal Surface. *a*, Buccal cusp; *c*, buccal ridge; *e*, *e*, buccal grooves; *f*, gingival line; *g*, mesio-bucco-occlusal angle; *h*, disto-bucco-occlusal angle; *i*, buccal root; *k*, lingual root.

Fig. 32* (Par. 48).—Right Upper First Bicuspid, Mesial Surface. *a*, Buccal cusp; *b*, lingual cusp; *c*, mesio-buccal-occlusal angle; *d*, mesial surface and point where there is often a concavity; *f*, *f*, gingival line; *e*, lingual root; *g*, buccal root.

Fig. 33* (Par. 50).—Upper First Bicuspid with three roots. Mesio-buccal angle.

Fig. 34* (Par. 50).—Upper First Bicuspid, with three short roots and of a peculiar form.

Fig. 35* (Par. 50).—Upper First Bicuspid, with a single, very long, crooked root.

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* Illustration, 1½ diameters.

found at its junction with the triangular grooves, into three parts: mesial (*o*), central (*l*), and distal (*p*). In the lower bicuspids the lingual lobe is often very small and the course of the grooves irregular.

UPPER FIRST BICUSPID.

42. The outline of the **occlusal surface** of the upper first bicuspid (Fig. 30), when seen in a line with the long axis of the tooth, is irregularly quadrilateral or trapezoidal, in form. The bucco-lingual diameter is about two-ninths greater than the mesio-distal. The flattened proximate surfaces converge toward the lingual, so that the mesio-distal measurement of the buccal portion is a little greater than the lingual. The buccal and lingual margins are convex. The buccal convexity forms an arc of about a quarter circle, and merges into the proximate surfaces by obtuse, but well defined, angles (*h*, *g*). The lingual margin forms an arc of nearly half a circle, and merges into the proximate margins without any angular prominence.

43. The occlusal surface has two prominent **cusps**—the buccal (*a*) and the lingual (*b*)—and is traversed from mesial to distal by a deep sulcus. The **buccal cusp** is the larger, and forms the terminal point of the buccal surface. From the point of this cusp, four ridges lead away at right angles. Two of these form cutting edges, which slope away mesially and distally to the mesio-bucco-occlusal (*h*) and disto-bucco-occlusal angles (*g*), where they join the mesial and distal marginal ridges. The central buccal ridge (*c*) leads away centrally on the buccal surface toward the gingival line, forming the convexity of this surface. The triangular ridge (*f*) slopes down to the central part of the crown and joins a similar ridge from the lingual cusp (*i*) to form the transverse ridge, or ends in a central sulcate groove (*l*). The **lingual cusp** (*b*) is in the form of a crescent; its convexity forms the occlusal margin of the lingual surface. Instead of a well-defined point it usually presents a blunt edge, which runs around its elevated central

portion, and joins with the marginal ridges at both angles. The lingual triangular ridge (*i*) leads down from the central point of the cusp to the central groove, to join its fellow from the buccal cusp in the formation of the transverse ridge, or is divided from it by a deep central sulcate groove. This ridge is seldom prominent. Very frequently the central incline of the lingual cusp is a plain surface.

44. The **mesial** (*d*) and the **distal** (*e*) marginal ridges are strong ridges of enamel which rise in the mesial and distal terminations of the cutting edges of the buccal cusp, and form the mesial and distal margins of the occlusal surface. They join with the ridge forming the lingual cusp, or they are usually divided from the latter by the mesial and distal grooves, though these grooves are often indistinct, especially in teeth that have been somewhat worn.

45. The occlusal surface of the bicuspids has five **developmental grooves**—the central (*l*), mesial (*m*), distal (*p*), mesial triangular (*m*), and distal triangular (*n*). The central groove is deeply sulcate, and divides the triangular ridges, or passes over their junction as a shallow line, and sinks into a triangular pit at either end. The mesial and distal grooves are really continuations of the central, which pass over the marginal ridges as very fine lines, or as more definite grooves, and mark the boundary of the lingual lobe. They are rarely fissured, while the central groove is frequently fissured throughout its course. The triangular grooves, mesial (*m*) and distal (*n*), run from the mesial and distal pits toward the mesio-buccal and disto-buccal angles, dividing the marginal ridges from the triangular. They are occasionally sulcate in the first part of their course, and are generally lost toward the mesio- and disto-buccal angles by becoming shallower; but in young, unworn teeth they can often be followed as a fine line running over the cutting edges of the buccal cusp near the angles, and leading into the buccal grooves (*r, s*). These are the marks of confluence of the mesial and distal lobes with the middle lobe. In the central incline of the lingual cusp, supplemental grooves are often seen meeting the triangular grooves of the buccal

Fig. 36.

Fig. 37.

Fig. 38.

Fig. 39.

Fig. 40.

Fig. 41.

FIG. 36* (Par. 51).—RIGHT UPPER SECOND BICUSPID, OCCLUSAL SURFACE. *a*, Point of buccal cusp; *b*, lingual cusp; *c*, buccal ridge; *e*, mesial marginal ridge; *d*, distal marginal ridge; *f*, triangular ridge of the buccal cusp; *g*, mesio-bucco-occlusal angle; *h*, disto-bucco-occlusal angle; *i*, triangular ridge of the original cusp; *l*, central groove; *m*, *n*, triangular grooves; *o*, *p*, buccal grooves.

FIG. 37* (Par. 52).—RIGHT UPPER SECOND BICUSPID, BUCCAL SURFACE. *a*, Point of buccal cusp; *c*, buccal ridge; *e*, *e*, buccal grooves; *f*, gingival line; *g*, mesio-bucco-occlusal angle; *h*, disto-bucco-occlusal angle; *i*, body of root; *k*, apex of root.

FIG. 38* (Par. 52).—RIGHT UPPER SECOND BICUSPID, MESIAL SURFACE. *a*, Buccal cusp; *b*, lingual cusp; *f*, gingival line; *i*, groove in the mesial side of the root.

FIG. 39* (Par. 52).—RIGHT UPPER SECOND BICUSPID, DISTAL SURFACE. *a*, Buccal cusp; *b*, lingual cusp; *c*, carious cavity near the proximate contact point; *f*, gingival line; *i*, groove in distal side of root.

FIG. 40* (Par. 53).—UPPER SECOND BICUSPID, with a very crooked root.

FIG. 41* (Par. 53).—UPPER SECOND BICUSPID, with a very short crook of the root.

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* Illustration, 1½ diameters.

side. The triangular grooves are occasionally fissured for a short distance from their junction with the central.

46. The **buccal surface** of the upper first bicuspid (Fig. 31) is similar to the labial surface of the cuspid (*q.v.*33). The cusp is usually nearer the center of the crown, and generally somewhat to the distal; therefore, the cutting edges which run from the summit of the cusp to either angle may be of about equal length. In some examples the distal edge is the longer; but usually the mesial edge is the longer. In the gingival half of its length this surface is smoothly convex from mesial to distal; but further toward the occlusal margin, the buccal ridge, which terminates in the cusp, becomes more prominent, and a shallow buccal groove (*e, e*) appears at both sides of the ridge, or between it and the angles. This surface is also considerably narrowed toward the gingival margin, almost equally on the mesial and distal, so that the crown seems much broader near the occlusal margin.

47. The **lingual surface** is regularly convex from mesial to distal. From the gingival margin to the summit of the lingual cusp it is often a straight line; but more generally it is slightly convex, in many examples almost as convex as the buccal surface.

48. The **mesial surface** (Fig. 32) is much flattened from buccal to lingual, but is generally slightly convex over its whole extent; yet in many examples there is a slight concavity near the gingival line. In the direction from the gingival line to the occlusal margin, this surface is slightly convex through its whole length, but not equally so through its buccal and lingual half. The lingual portion is progressively more rounded toward the occlusal surface; while the buccal portion is nearly straight to the bucco-occlusal angle.*

* The form of the proximate surfaces is especially important in making contour fillings, for any concavity increases the difficulty of forming good, clean margins at the gingival border. The unequal convexity of the buccal and lingual halves is important, and requires a special adaptation of instruments to make a perfect contour and good, clean margins.

49. The form of the **distal surface** agrees substantially with the mesial, but is rather more convex in all directions and any concavity is rare.

50. The **root** of the upper first bicuspid is usually either much flattened and grooved on its mesial and distal sides, or separated into two divisions, one-third to two-thirds of its length, making one **buccal** and one **lingual** root. More than half have their roots thus divided. When separated, the roots taper regularly to slender apexes. When not divided, the apex is apt to be obtuse. Occasionally this tooth presents three divisions of the root, two buccal and one lingual (Figs. 33, 34). In some instances the root of this tooth is very crooked or otherwise distorted (Fig. 35).

UPPER SECOND BICUSPID.

51. The upper second bicuspid so nearly resembles the upper first, just described, that a notice of its differences will be sufficient. It is a little smaller, and in every way more slender.* The general form of the **occlusal surface** (Fig. 36) is similar to the first bicuspid. It presents a buccal and a lingual cusp, and similar sulcus, ridges, grooves, and pits. The average height of the cusps is considerably less than in the first bicuspid. The marginal ridges are proportionally broader, the mesial and distal pits closer to each other, and the central groove shorter. The triangular grooves join the central groove nearer the mesio-distal center of the tooth, making the buccal triangular ridge narrower and more nearly pointed. In many examples the enamel of the occlusal surface is thrown into several shallow wrinkles, or supplemental grooves and ridges, which radiate from the central groove, which occurs but rarely in the first bicuspid. The buccal cusp is a little nearer the mesio-buccal than the disto-buccal angle, so that the distal edge is slightly the longer.

52. From mesial to distal, the **buccal surface** (Fig. 37) is not so broad at the occlusal surface, and is a little broader

* The popular opinion is that the second bicuspid is the larger.

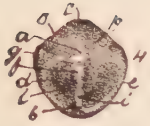

Fig. 42.

Fig. 43.

Fig. 44.

Fig. 45.

Fig. 46.

Fig. 47.

Fig. 42* (Par. 54).—Right Lower First Bicuspid, Occlusal Surface. *a*, Point of buccal cusp; *b*, lingual cusp or ridge; *c*, buccal ridge; *d*, mesial marginal ridge; *e*, distal marginal ridge; *f*, triangular ridge of buccal cusp or buccal triangular ridge; *g*, mesio-bucco-occlusal angle; *h*, disto-bucco-occlusal angle; *i*, central groove crossing the transverse ridge; *l*, mesial pit; *o*, *p*, buccal grooves.

Fig. 43* (Par. 54).—Lower First Bicuspid, Occlusal Surface. *a*, Point of buccal cusp; *b*, lingual cusp or ridge; *c*, triangular ridge of buccal cusp deflected to one side; *d*, triangular groove with fissure; *e*, mesial marginal ridge; *f*, distal marginal ridge.

Fig. 44* (Par. 57).—Right Lower First Bicuspid, Buccal Surface. *a*, Buccal cusp; *d*, buccal ridge; *e*, *e*, buccal grooves; *f*, gingival line; *g*, disto-bucco-occlusal angle; *h*, mesio-bucco-occlusal angle; *i*, body of root, *k*, apex of root.

Fig. 45* (Par. 58).—Left Lower First Bicuspid, Mesial Surface. *a*, Buccal cusp; *b*, lingual cusp or ridge; *c*, distal marginal ridge; *d*, triangular ridge of buccal cusp; *e*, mesial marginal ridge; *f*, gingival line.

Fig. 46* (Par. 59).—Left Lower First Bicuspid, Lingual Surface. *a*, Buccal cusp; *b*, lingual cusp or ridge; *c*, distal marginal ridge; *d*, triangular ridge of buccal cusp; *e*, mesial marginal ridge; *f*, gingival line.

Fig. 47* (Par. 59).—Right Lower First Bicuspid, Lingual Surface. *a*, Buccal cusp; *b*, lingual cusp or ridge; *d*, triangular ridge or buccal cusp; *e*, *e*, marginal ridges; *f*, gingival line.

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* Illustration, 1½ diameters.

at the neck, so that it has not so much of the bell-crown appearance as the first bicuspid. Otherwise, this surface has the same, but less definitely defined outlines and markings. The **mesial and distal surfaces** (Figs. 38 and 39) are generally slightly more convex, and the crown more smoothly rounded. The mesial surface seldom shows a concavity. The **lingual surface** is usually a little more rounded toward the cutting edge or crest of the cusp. Generally, the distal side of the lingual cusp is rounded to such an extent as to bring the summit of the cusp to the mesial of the central line of the tooth. The **gingival line**, in its course round the neck of the tooth, makes but a slight bucco-lingual curvature on the mesial surface. Generally there is no curvature on the distal surface.

53. The **root** of the upper second bicuspid is a little longer than the first, while the crown is slightly shorter, which makes the proportionate increase of length appear considerable. The root is rarely divided in any part of its length, but is much flattened from the neck to the apex. The mesial side is often deeply grooved in the apical third of its length; the distal side is less frequently grooved. The root tapers very gradually, remaining broad in the bucco-lingual diameter, and ends in a blunt apex. A few have a root that tapers rapidly, becomes more rounded, and ends in a slender apex. Crooked roots are more frequent in this than in the other bicuspids. (Figs. 40 and 41.)

LOWER FIRST BICUSPID.

54. This tooth is the smallest of the bicuspids. The **occlusal surface** differs much from the upper first bicuspid. Indeed, the lingual cusp is so nearly wanting, it would hardly be called a bicuspid except for its association. The buccal cusp is large and prominent, and so much is the buccal surface inclined lingually, that, when seen in a line with the long axis of the tooth, its point occupies a position about one-third distant from the buccal toward the lingual outline of the crown (Figs. 42 and 43). The buccal cusp presents the same

ridges leading from its summit as described for the upper first bicuspid (Par. 43), but the pair which form the cutting edges usually form a curve with its convexity to the buccal, and merge into the marginal ridges by more rounded angles. The buccal triangular ridge is narrow and prominent (*f*), and joins the elevated lingual ridge, or cusp (*b*), forming a complete transverse ridge. In many instances this is deflected to the mesial or distal. In young teeth, the central groove often crosses the transverse ridge as a fine line, which soon disappears by wear. However, in many examples the transverse ridge is divided by a deeply sulcate groove. There is a deep pit at the mesial and the distal ends of the central groove, or on either side of the transverse ridge (*c, d*) from which the triangular grooves, which divide the marginal ridges from the triangular, or transverse ridge, run toward the mesio- and disto-buccal angles. These are often sulcate in the first part of their course. In many young teeth these grooves may be traced over the cutting edges onto the buccal surface, marking the confluence of the central with the mesial and distal buccal lobes.

55. The **lingual lobe** varies much in its size and outline. It is divided from the three buccal lobes by the mesial, distal, and central grooves; and often occupies but a small portion of the lingual margin of the occlusal surface. The grooves which mark its outlines are often indistinct, and often obliterated by wear. The lobe may form a ridge of even height, and join the marginal ridges, or it may be elevated into one or more tubercles. It may, also, be raised into a small cusp, located centrally, or to either side of the central line of the tooth.

56. The **marginal ridges** are occasionally quite small, but in most examples they are well developed, and cause the mesial and distal surfaces to stand out prominently, giving the tooth a strong, well-crowned appearance. The length of the marginal ridges varies with the size of the lingual lobe.

57. The **buccal surface** (Fig. 44) is convex in all direc-

tions. The cusp is to the distal of the perpendicular line and its figure similar to the upper first bicuspid, except that its surface is more convex. As the occlusion is directly on the point of the cusp, as with the anterior lower teeth generally, it is soon so worn down that its prominence is lost.

58. The **mesial** and **distal surfaces** are convex from buccal to lingual. In the direction from the occlusal margin to the gingival line, they are generally concave, after passing the convexity of the immediate occlusal margin. This latter stands out boldly to both mesial and distal, giving a marked bell-crowned form. The concavity of the mesial and distal surfaces is not so well seen from the buccal view as from the lingual. The greater overhang of the crown (over the root), and the greater concavity, are toward the lingual portion.

59. The **lingual surface** (Figs. 46 and 47) is smoothly rounded from mesial to distal, and slightly convex in the direction of the length of the tooth. It is only about half as long as the buccal surface (in unworn teeth), and when viewed at right angles with the long axis of the tooth, all of the occlusal surface on the lingual side of the buccal cusp is seen except the pits and sulci.

60. The **neck** of the tooth is much constricted, and has a deep gingival line. This makes the proper adjustment of a band for an artificial crown particularly difficult. The curvature of the gingival line is much less than in the upper first bicuspid, the average being less than one millimeter (*q. v.* table of measurements).

61. The **root** of this tooth is somewhat flattened at the neck, on lines that converge rapidly toward the lingual, and often grooved on its mesial and distal sides, and sometimes the root is bifurcated. It tapers regularly, with a tendency to a more nearly round form at the apex, and generally ends in a slender point. The root is generally straight, or the lingual surface is straight, and the buccal surface convex. This convexity extends from the apex of the root to the point of the crown, which gives that characteristic appearance so peculiar to the anterior lower teeth.

LOWER SECOND BICUSPID.

62. The lower second bicuspid is a little longer than the lower first, and of much the same figure, except that the lingual cusp is proportionately higher and more nearly, but never quite, on a level with the buccal, but the lingual surface is about equal to the buccal in mesio-distal breadth. These teeth are regular in general contour, but the grooves of the occlusal surface are much diversified. These differences may be classified under three forms: 1st. The central groove joins the triangular grooves in such a way as to form a half circle with the convexity to the lingual, with or without a transverse ridge crossing its line. In these, when the transverse ridge is high, only a deep pit appears on either side (Fig. 48). 2d. The lingual cusp is divided by a sulcate groove, which runs over centrally, or nearly so, to the lingual surface, making a three-cuspid tooth (Fig. 49). The central groove forms an angle at the junction with the lingual, or is crescentic in form. It joins with the triangular grooves in such a way that the point of junction cannot be told except by finding the mesial and distal grooves, which are often very indistinct. 3d. The central groove is straight, and generally sulcate, with a deep pit at each end. In many examples these pits are crossed by the triangular grooves almost at right angles with the central (Fig. 50). By tracing the fine mesial and distal grooves carefully in young unworn teeth, it will be found that the lingual lobe is much larger than in the lower first bicuspid, and almost as large as in the upper bicuspids. In the three-cusped forms the two lingual lobes are usually a little broader from mesial to distal than the buccal portion of the tooth.

63. The buccal surface (Fig. 51) of the lower second bicuspid does not differ from the other bicuspids, except in being shorter, the cusp lower. The lingual surface (Fig. 52) is broader and smoothly convex; in the three-cusped forms it is often somewhat flattened and grooved in its occlusal third, giving the crown a squarish appearance, or even triangular when the lingual lobes are large.

Fig. 48.

Fig. 49.

Fig. 50.

Fig. 51.

Fig. 52.

Fig. 53.

FIG. 48* (Par. 62).—LEFT LOWER SECOND BICUSPID, OCCLUSAL SURFACE. *a*, Buccal cusp; *b*, lingual cusp or ridge; *c*, *e*, marginal ridges; *d*, *f*, pits; *g*, *h*, triangular grooves.

FIG. 49* (Par. 62).—RIGHT LOWER SECOND BICUSPID, OCCLUSAL SURFACE, with three cusps, *a*, Buccal cusp; *b*, mesio-lingual cusp; *c*, disto-lingual cusp; *d*, lingual groove; *e*, *e*, mesial and distal grooves.

FIG. 50* (Par. 62).—RIGHT LOWER SECOND BICUSPID, OCCLUSAL SURFACE, with straight central groove. *a*, Buccal cusp; *b*, lingual cusp; *c*, *e*, marginal ridges; *d*, triangular ridge of the buccal cusp; *f*, central groove; *g*, *h*, triangular grooves.

FIG. 51* (Par. 63).—LEFT LOWER SECOND BICUSPID, BUCCAL SURFACE. *a*, Buccal cusp; *d*, buccal ridge; *e*, *e*, buccal grooves; *f*, gingival line; *g*, mesio-bucco-occlusal angle; *h*, disto-bucco-occlusal angle; *i*, body of root; *k*, apex of root.

FIG. 52* (Par. 63).—LEFT LOWER SECOND BICUSPID, LINGUAL SURFACE. *a*, Buccal cusp; *b*, lingual cusp; *c*, distal marginal ridge; *d*, triangular ridge of the buccal cusp; *e*, mesial marginal ridge; *f*, gingival line.

FIG. 53* (Par. 64).—LEFT LOWER SECOND BICUSPID, MESIAL SURFACE. *a*, Buccal cusp; *b*, lingual cusp; *d*, triangular ridge; *e*, mesial marginal ridge; *f*, gingival line; *i*, groove in mesial side of the root.

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* Illustration, 1½ diameters.

64. The mesial and distal surfaces in these bicuspids are a little flattened, but remain convex from buccal to lingual. From the occlusal margin to the gingival line, they are nearly straight, though some are convex and some in part concave.

65. The **root** of the lower second bicuspid is larger and longer than that of the first bicuspid. It is flattened on the mesial and distal surfaces on nearly parallel lines, and in some examples concave or grooved. In rare instances the root of this tooth is deeply grooved on the buccal and lingual sides, with a tendency to a division into a mesial and distal prong. In the greater number it tapers regularly to a slender apex, but in many the apex is large and obtuse. The root is generally straight, but occasionally very crooked.

THE MOLAR TEETH.

66. The molar teeth are very different in form and plan of construction from those previously described. They are particularly designed for grinding or comminuting food; for this purpose they have broad occlusal surfaces, broken by ridges, grooves, and fossæ. The ridges are raised at intervals into powerful cusps, which fit with more or less accuracy into the sulci and fossæ of the opposing teeth. There are twelve molars, three on each side of the upper jaw and three on each side of the lower jaw. They are the sixth, seventh and eighth teeth from the median line, and are commonly named the first, second and third molars, upper and lower. The last is also called the wisdom tooth, or *Dens Sapientia*. The upper and lower molars are much alike in size and general contour, but in the detail of the arrangement of their lobes, cusps, fossæ and grooves, they are different. It will, therefore, be necessary to describe the upper and lower molars separately.

THE UPPER MOLARS.

67. The three upper molars are similar, but present minor differences of detail, consisting mostly in a less pronounced, or typical development of certain parts, or lobes, of the second and third molars (Fig. 62). The upper first molar

being the **typical form**, will be described first, and afterward the deviations from this type that occur in the second and third molars.

UPPER FIRST MOLAR.

68. The **occlusal surface** of the upper first molar (Fig. 54), when seen in a line with the long axis of the tooth, presents an outline of irregular rhombic form, with the mesio-buccal and disto-lingual as acute angles. The angles are rounded, with more or less convexity of the marginal lines. This surface presents two principal fossæ, and four developmental grooves. These grooves divide the crown into four lobes, or primary developmental parts, each of which is surmounted by a strong cusp. These lobes, or cusps, are the mesio-buccal (Fig. 54, *a*), disto-buccal (*b*), mesio-lingual (*c*), and disto-lingual (*d*). Of the **grooves** which outline these parts, three rise from the central pit of the central fossa: The **mesial** (*h*), which runs to the mesial margin; the **buccal** (*i*), which runs in a deep sulcus to the buccal margin, and over it onto the buccal surface; and the **distal** (*j*), which runs distally, and lingually, over the oblique ridge and ends in the distal fossa (*k*). The remaining groove—the **disto-lingual** (*k, k*)—begins a little to the buccal of the central part of the distal margin, and runs diagonally in a straight line, or in a curve with the concavity toward the disto-lingual angle, to the lingual margin, and over it onto the lingual surface, to become the **lingual groove.** Except that part crossing the distal marginal ridge, this groove is usually deeply sulcate.

69. In their origin, each **lobe** begins its calcification as a separate piece, plate, or cusp, and moves apart from the others as growth proceeds, till the proper dimensions of the occlusal surface are attained; then the plates coalesce on the lines marked by the grooves named above, and thus complete the occlusal surface. When the union has been completed, nothing but fine lines remain, which, on any plain parts, are often quickly obliterated by wear. But on parts meeting at

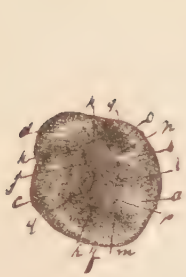

Fig. 54

Fig. 55

Fig. 56

Fig. 57.

Fig. 58

FIG. 54* (Par. 68).—RIGHT UPPER FIRST MOLAR, OCCLUSAL SURFACE, with four cusps. *a*, Mesio-buccal cusp; *b*, disto-buccal cusp; *c*, mesio-lingual cusp; *d*, disto-lingual cusp; *f*, mesial marginal ridge; *g*, distal marginal ridge; *h*, mesial groove; *i*, buccal groove; *j*, distal groove; *k*, *k*, disto-lingual groove; *m*, mesio-buccal triangular groove; *n*, disto-buccal triangular ridge; this unites with the distal ridge from the lingual cusp to form the oblique ridge; *o*, disto-buccal triangular groove; *p*, mesio-buccal triangular ridge; *q*, central pit.

FIG. 55* (Par. 70).—RIGHT UPPER FIRST MOLAR, OCCLUSAL SURFACE, with five cusps. *a*, Mesio-buccal cusp; *b*, disto-buccal cusp; *c*, mesio-lingual cusp; *d*, disto-lingual cusp; *e*, fifth cusp; *f*, mesial marginal ridge; *g*, distal marginal ridge; *h*, mesial groove; *i*, buccal groove; *j*, distal groove; *k*, *k*, disto-lingual groove; *l*, *k*, mesio-lingual groove; the lingual cusps are faceted by wear; *m*, mesio-buccal triangular groove; *n*, disto-buccal triangular ridge.

FIG. 56* (Par. 78).—RIGHT UPPER FIRST MOLAR, BUCCAL SURFACE. *a*, Mesio-buccal cusp; *b*, disto-buccal cusp; *c*, mesio-lingual cusp; *d*, disto-lingual cusp; *e*, buccal ridge; *f*, gingival line; *g*, mesio-bucco-occlusal angle; *h*, disto-bucco-occlusal angle; *i*, buccal groove; *k*, mesial root; *l*, distal root; *m*, lingual root.

FIG. 57* (Par. 79).—RIGHT UPPER FIRST MOLAR, LINGUAL SURFACE. *a*, Mesio-buccal cusp; *b*, disto-buccal cusp; *c*, mesio-lingual cusp; *d*, disto-lingual cusp; *e*, fifth cusp; *f*, gingival line; *g*, disto-lingual groove; *h*, mesio-lingual groove; *i*, lingual groove; *k*, mesial root; *l*, distal root; *m*, lingual root.

FIG. 58* (Par. 80).—RIGHT UPPER FIRST MOLAR, MESIAL SURFACE. *a*, Mesio-buccal cusp; *b*, disto-buccal cusp; *c*, mesio-lingual cusp; *d*, disto-lingual cusp; *e*, fifth cusp; *f*, *f*, gingival line; *h*, mesio-lingual groove; *k*, mesial root; *l*, distal root; *m*, lingual root.

* Illustration, 1½ diameters.

an angle, forming a sulcus, as in the buccal and disto-lingual grooves, there is usually a sharp groove, and at any point where the union has been imperfect, there is a **fissure.*** Fissures are most frequent at the ends of the grooves, near the central pit, or where they are deeply sulcate, and in the central portion of the disto-lingual groove; but they may occur in any part of these lines.

70. In many examples of the upper first molars, but in no others, there is a small **fifth lobe** or cusp (Fig. 55, *e*). This is situated on the lingual side of the mesio-lingual lobe, from which it is divided by a fifth groove, the **mesio-lingual** (*l, k*), which runs from the lingual portion of the mesial margin diagonally to the lingual margin, and joins the lingual groove. This cusp, when it occurs, is always bilateral, *i.e.*, on both the right and left upper first molars. It is hereditary, appearing regularly in the teeth of children when present in the teeth of both parents. It occurs also, in a modified form, when present in but one parent. Therefore, the cusp will be found in all possible varieties of development, from its largest size, as represented in Fig. 55, to the merest line marking its position on the lingual side of the mesio-lingual cusp.

71. The occlusal surface of the upper first molar has four **marginal ridges**, broken by the grooves described (Par. 68), so as to form four principal eminences or cusps. These are the buccal, lingual, mesial, and distal marginal ridges. Of these, the mesial and distal marginal ridges are close upon the margins of the surface. But the buccal and lingual are carried toward the central line of the tooth by the inclination of the buccal and lingual surfaces. In the upper molars the central inclination of the lingual surface is much greater than that of the buccal; while in the lower molars the central inclination of the buccal surface is the greater. The **buccal marginal**

* In large strong teeth it seems that the growth of the dentine pulp is often too great for the enamel cap, so that the enamel-forming cells are drawn apart, preventing a union of the enamel plates; hence fissures are more frequent in large teeth.

ridge begins at the mesio-buccal angle, in the form of a blunt cutting edge, and rises in a curved line to the summit of the mesio-buccal cusp (Fig. 54, *a*), from which it descends distally to the buccal groove (*i*). From the summit of this cusp the mesio-buccal triangular ridge (*p*) descends to the mesial side of the central pit (*q*). This ridge is divided from the mesio marginal ridge by the mesio-buccal supplemental groove (*m*), which is sometimes deep, but generally shallow, and occasionally absent. From the buccal groove the marginal ridge rises rapidly to the summit of the disto-buccal cusp (*b*), then descends in a curve to the disto-buccal angle, to join the distal marginal ridge (*g*). From the point of this cusp the disto-buccal triangular ridge (or triangular ridge of the disto-buccal cusp, *n*), runs down to the distal side of the central pit, where it joins a ridge from the mesio-lingual cusp to form the **oblique ridge**, or is divided from this ridge by a sulcate distal groove.

72. The **lingual marginal ridge** begins at the mesio-lingual angle as a rounded edge, and rises in a curve to the summit of the mesio-lingual cusp (*c*), and descends, continuing its curve, into a ridge, meeting the triangular ridge of the disto-buccal cusp to form the oblique ridge. However, in a less pronounced form, this marginal ridge descends from the summit of the mesio-lingual cusp to the distal, where it is deeply broken by the disto-lingual groove. On the distal side of this groove it rises abruptly to the summit of the disto-lingual cusp (*d*), from which it slopes away in a curve to join the distal marginal ridge.

73. The **mesial marginal ridge** (*f*) is a strong band of enamel running from the mesio-buccal to the mesio-lingual angle of the occlusal surface. It forms the mesial boundary of the occlusal surface, and the angle of junction of the mesial and occlusal surfaces, or the mesio-occlusal angle. It is low in the center of its length, and rises toward both angles. It is crossed near its center by the mesial groove, usually as a fine line, which is often obliterated by wear early in life.

Occasionally one or more small tubercles appear in the central portion of this ridge, inclosed in what seems to be a division of the mesial groove.

74. The **distal marginal ridge** (*g*) is a band of enamel forming the distal boundary of the occlusal surface, from angle to angle, and forms the angle of junction between the occlusal and the distal surfaces, or the disto-occlusal angle. It is low in the center of its course, and is crossed by the distal end of the disto-lingual groove as a fine line, usually a little to the buccal of the central point.

75. The **central fossa** is irregularly circular, and is formed by the central inclines of the mesial marginal ridge, mesio-buccal cusp, disto-buccal cusp, mesio-lingual cusp, and oblique ridge. It is made irregular, and sometimes angular, by the depth of the several sulcate grooves, or by the prominence of the triangular ridges, especially that from the mesio-buccal cusp. The central incline of the mesio-lingual cusp is generally a plane surface, but is sometimes slightly concave, and in about a fourth of its examples there is a low, triangular ridge running from its apex directly to the central pit. The oblique ridge is occasionally cut through by a deep and wide distal sulcus, thus connecting the central with the distal fossa. In a few examples two supplemental grooves or wrinkles arise from the mesial groove at about the center of its length, and run, one toward the mesio-buccal and the other toward the mesio-lingual angle of the occlusal surface. These are often of such depth and width as to form a small supplemental mesial fossa. Of these grooves, the mesio-lingual is generally absent, and the mesio-buccal (*m*) is generally present, though often very shallow.

76. The **distal fossa** is formed by the distal incline of the disto-buccal and mesio-lingual cusps and oblique ridge, which meet the central incline of the disto-lingual cusp and distal marginal ridge. It is traversed by the disto-lingual groove, which is generally sulcate, and deepens into a pit at the point where it receives the distal groove. From the buccal

portion a supplemental groove, the disto-buccal, runs well up toward the summit of the disto-buccal cusp, dividing its triangular ridge from the distal marginal ridge.

77. In some molars many **supplemental grooves** or wrinkles radiate from the centers of these fossæ on the inclines of the ridges and cusps, and in some poorly developed teeth these are deeply fissured. The growth of enamel seems to have reached out toward the line of junction in the form of spiculæ, and to have failed to fill out the space.

78. The **buccal surface** of the upper first molar (Fig. 56) is irregularly convex. Its length is about equal to the mesio-distal breadth at the gingival line, while the width at the widest point, near the occlusal margin, is about three-tenths greater. Therefore, the mesial and distal margins converge toward the neck. The mesial margin is almost straight, after the rounding of its mesio-occlusal angle, but the distal is convex. The occlusal margin is surmounted by the buccal cusps (*a*, *b*), between which there is a deep notch, through which the buccal groove passes from the occlusal to the buccal surface. This groove passes centrally toward the gingival line about half the length of this surface, dividing the occlusal portion into a mesial and distal buccal ridge. In some examples the groove continues across the gingival line to the bifurcation of the roots. There is a bucco-gingival ridge of enamel (*e*) near the gingival line which the buccal groove generally does not cross. The mesio-distal convexity is greatest on this ridge, and diminishes toward the occlusal margin. The summit of this convexity is on the mesial half, in a line with the mesial root, and the surface falls away rapidly toward the disto-buccal angle of the tooth.

79. The **lingual surface** (Fig. 57) is divided in a line with the long axis of the tooth into a mesial and distal lobe by the lingual groove (*i*). Both lobes are smoothly convex from mesial to distal, and in a less degree from the gingival line (*f*) to the occlusal margin. The gingival line is nearly horizontal, and so sunken as to give the appearance of a gin-

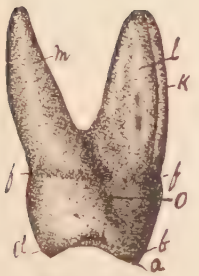

Fig. 59

Fig. 60.

Fig. 61.

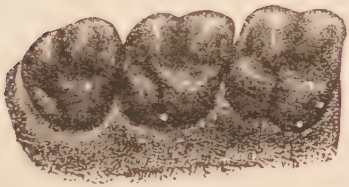

Fig. 62.

FIG. 59* (Par. 81).—RIGHT UPPER FIRST MOLAR, DISTAL SURFACE. *a*, Mesio-buccal cusp; *b*, disto-buccal cusp; *d*, disto-lingual cusp; *f*, *f*, gingival line; *k*, mesial root; *l*, distal root; *m*, lingual root; *o*, concavity of the distal surface.

FIG. 60* (Par. 82).—LEFT UPPER FIRST MOLAR, BUCCAL SURFACE. A bell crowned tooth.

FIG. 61* (Par. 85).—UPPER FIRST MOLAR showing the mesial and distal roots united at their apexes.

FIG. 62* (Par. 86).—THE RIGHT UPPER MOLARS showing the progressive diminution of the disto-lingual cusp from the first to the third molar.

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* Illustration, 1½ diameters.

gival enamel ridge. The occlusal margin is surmounted by the mesio- and disto-lingual cusps (*c*, *d*), of which the mesial is usually the larger. In the five-cusped molar the fifth cusp (*e*) is seen on the mesio-lingual lobe. The mesial and distal margins are convex, converging rapidly toward the lingual root. In the few examples in which the lingual groove is not apparent, the lingual surface is smoothly convex from mesial to distal.

80. The **mesial surface** (Fig. 58) is nearly flat in all directions, and its margins are rounded to the buccal and lingual surfaces. Toward the occluso-buccal angle, the flat surface is continued well up to the occlusal surface, which it meets in a fairly sharp angle; but as it approaches the linguo-occlusal portion it is progressively rounded toward the occlusal surface. In many molars, near the gingival line, half-way from buccal to lingual, this surface is a little concave.

81. The **distal surface** (Fig. 59), in its lingual half, is convex in all directions, but in its buccal half there is often a concavity formed by a considerable distal protrusion of the disto-lingual lobe. This is a shallow, but marked, depression (*o*), running from the bifurcation of the distal and the lingual roots toward the disto-buccal cusp. It crosses the gingival line at a point about one-third distant from the buccal toward the lingual margin. In many examples this depression is more central and receives the distal termination of the disto-lingual groove, which may often be traced as a fine line nearly or quite to the gingival border of the enamel. This complication of the surface makes the finishing of fillings, and the fitting of bands for crowns, specially difficult. This depression falls short of forming a concavity in about one-fourth of the first molars.

82. The **root** of the upper first molar (Figs. 56 to 61) is divided into three prongs or roots*—the mesial, or mesio-

* The divisions of the root of a tooth are usually called "the roots," and the upper molars are said to have three roots. The neck of the tooth is, however, common to all, and, more strictly, there is one root divided into several prongs, or fangs. Some authors follow this form of expression. For instance, Prof. Judd says: "The root of a molar is divided into three fangs." I see no good reason, however, for not calling them roots, the term generally in use by the dental profession.

buccal (*k*), the distal or disto-buccal (*l*), and the lingual (*m*). These are usually quite widely separated, giving the tooth a firm seat in its alveolus. The **lingual root** is the largest; it diverges boldly to the lingual, and is straight, or slightly curved, with the convexity to the lingual. It is conical, and tapers regularly to an obtuse rounded apex. In most molars it has a groove, a continuation of the lingual, on its lingual side, running nearly, or quite, its whole length. In rare examples this root bifurcates.

83. The **mesial root** (*k*) is larger than the distal; broad from buccal to lingual, and thin from mesial to distal, with the lingual portion the thinner, and grooved on its flattened sides. It diverges first to the mesial and buccal, and then curves to the distal. It tapers mostly at the expense of the lingual thin edge, and ends in a flattened or rounded apex.

84. The **distal root** (*l*) is the smallest of the three. It diverges to the distal and buccal, and is straight, or slightly curved, sometimes to the distal, sometimes to the mesial, so that its apex approaches the mesial root. It is flattened on its mesial and distal sides, but less than the mesial root, and tapers to a more rounded form, ending in a slender point.

85. The **roots** of the first molar are, perhaps, more regular in form than those of any other of the molar teeth; but even in these, considerable deviation from the forms described will occasionally be observed (Figs. 60 and 61).

UPPER SECOND MOLAR.

86. The most constant difference between the **occlusal surfaces** of the upper first and second molars is that the latter tooth is smaller, and has an almost constant tendency to a relatively smaller size of the **disto-lingual lobe.** This tendency is well seen in Fig. 62, in which the upper molars of a very well formed denture are drawn from the cast. This shows the disto-lingual lobe progressively diminished, so that in the third molar it is very small. When a large number of second molars are examined, it is found that the central fossæ are not

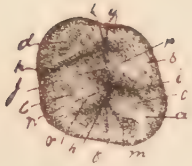

Fig. 63.

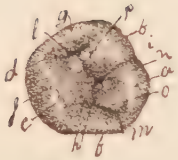

Fig. 64.

Fig. 65.

Fig. 66.

Fig. 67.

Fig. 68.

Fig. 63* (Par. 86).—Right Upper Second Molar, Occlusal Surface, with three of the cusps faceted by wear. Tooth large and especially well developed. *a*, Mesio-buccal cusp; *b*, disto-buccal cusp; *c*, mesio-lingual cusp; *d*, disto-lingual cusp; *f*, mesio marginal ridge; *g*, distal marginal ridge; *h*, mesial groove; *i*, buccal groove; *j*, distal groove; *k*, disto-lingual groove; *l*, distal fossa; *m*, mesio-buccal triangular groove; *n*, central pit; *o*, mesio-buccal triangular ridge; *p*, disto-buccal triangular ridge; *r*, mesio-lingual triangular ridge.

Fig. 64* (Par. 86).—Right Upper Second Molar, Occlusal Surface. Tooth of medium size and imperfect form. *a*, Mesio-buccal cusp; *b*, disto-buccal cusp; *c*, mesio-lingual cusp; *d*, disto-lingual cusp; *f*, mesial marginal ridge; *g*, distal marginal ridge; *h*, mesial groove; *i*, buccal groove; *l*, distal fossa. The disto-lingual groove is imperfect; *m*, mesio-buccal triangular groove; *o*, mesio-buccal triangular ridge; *p*, disto-buccal triangular ridge, which unites with the ridge from the mesio-lingual cusp to form the oblique ridge.

Fig. 65* (Par. 87).—Right Upper Second Molar, showing a form of deformity peculiar to this tooth that is not very common.

Fig. 66* (Par. 89).—Right Upper Second Molar with the roots inclined to the distal.

Fig. 67* (Par. 90).—Right Upper Second Molar, Distal Surface, with the three roots compressed into one.

Fig. 68* (Par. 90).—Right Upper Second Molar, showing the distal and lingual roots united.

* Illustration, 1½ diameters.

so regularly formed as in the first, being often small, even in large, well-developed teeth (Fig. 63), and the cusps comparatively low, with a relatively greater inclination of the lingual surface toward the summit of the mesio-lingual cusp. In many examples the distal fossa is reduced to a mere pit (Fig. 64), and the lingual marginal ridge is continued from the summit of the mesio-lingual cusp distally to the disto-lingual angle, where it joins the distal marginal ridge, as in Fig. 64, making practically a **three-cusped** tooth. In many of these, after the tooth is a little worn, the disto-lingual groove cannot be traced across the lingual marginal ridge, nor on the lingual surface; but a fine line is generally seen crossing the distal marginal ridge.

87. The **upper second molar** is liable to a peculiar deformity, which I have not seen in any other tooth. The crown is greatly flattened from mesial to distal, occasionally to such an extent as to present none of its usual lines. In the extreme cases (Fig. 65) there is one central, long-shaped sulcus running from buccal to lingual, formed by the central inclines of a ridge encircling the occlusal surface. This ridge may be broken at intervals by shallow grooves crossing it. Usually, much of the central inclination of this ridge is wrinkled, and often there are many small fissures. The mesial surface is commonly deeply concave, and the distal convex.

88. In well-developed second molars, the form of the **buccal, lingual, mesial** and **distal surfaces** is much the same as in the first molar, though rather more convex, and concavities in the mesial and distal surfaces are not so frequent. However, in teeth with large disto-lingual cusps, the concavity of the distal surface is about the same as in the first molar (Par. 81). The lingual groove is generally not sulcate, though it is usually seen as a fine line in unworn teeth. It is often near the disto-lingual angle, and, when sulcate, it generally disappears by becoming shallower about half-way toward the gingival line; rarely it runs across the gingival line, and in that case the lingual root is grooved, as in the first molars.

89. The **neck** of the tooth is less regular in its outline than in the first molar. In the average, it is more flattened from mesial to distal, and on lines that converge more to the lingual. On the buccal surface, the mesio-buccal ridge is relatively more prominent, and at the neck the surface slopes away more toward the distal, so that in many examples the distal root seems compressed between the mesial and lingual roots.

90. The **roots** of this tooth are the same in number and general form as in the first molar, but they spread less, and are curved more to the distal (Fig. 66). There is also much more variety of the comparative size of the root and crown than in the first molar. In many the root is single, with the outlines of the division marked by grooves of variable depth (Fig. 67); or two of the roots may be connected, while the third is free. Sometimes this union is the lingual with the distal (Fig. 68); but oftener it is the lingual with the mesial root.

UPPER THIRD MOLAR.

91. The upper third molar deviates from the typical form of the first more than does the second. Yet, in dentures of the best form, it presents the same developmental lines, fossæ, and cusps (Fig. 69). The **disto-lingual lobe** is very much smaller, and in many examples is entirely wanting. Of the examples in my possession, about twenty-one per cent. show a diminutive disto-lingual cusp; thirty-two per cent. show a pit in the position of the distal fossa, and some portion of the disto-lingual groove, but no depressed groove over the lingual marginal ridge; it is similar to that shown in Fig. 64. The remainder, or about forty-seven per cent., have no disto-lingual lobe. Of the latter, three fourths are properly **three-cuspid teeth** in which the oblique ridge becomes the distal marginal ridge, and the distal groove runs over to the distal surface (Fig. 70). In the remainder, there is only an irregular ridge (Fig. 71), forming a central fossa, so marked with wrinkles or supplemental grooves that the developmental lines are not satis-

Fig. 69.

Fig. 70.

Fig. 71.

Fig. 72.

Fig. 73.

Fig. 69* (Par. 91).—Right Upper Third Molar, Occlusal Surface, of typical form. *a*, Mesio-buccal cusp; *b*, disto-buccal cusp; *c*, mesio-lingual cusp; *d*, disto-lingual cusp; *e*, mesial marginal ridge; *f*, distal marginal ridge; *g*, mesio-buccal triangular ridge; *h*, disto-buccal triangular ridge; *i*, mesial groove; *k*, buccal groove; *l*, distal groove; *m*, disto-lingual groove; *n*, central pit; *o*, mesio-buccal triangular groove.

Fig. 70* (Par. 91).—Right Upper Third Molar, Occlusal Surface, three cusped. *a*, Mesio-buccal cusp; *b*, disto-buccal cusp; *c*, lingual cusp; *e*, mesial marginal ridge; *h*, distal marginal ridge; *l*, mesial groove; *k*, buccal groove; *l*, distal groove; *o*, mesio-buccal triangular groove.

Fig. 71* (Par. 91).—Right Upper Third Molar, Occlusal Surface Young, unworn tooth of imperfect form. *a*, Mesio-buccal cusp; *b*, disto-buccal cusp; *c*, lingual cusp; *e*, mesial marginal ridge; *f*, distal marginal ridge; *g*, mesial groove; *h*, buccal groove; *i*, *distal groove*. Several supplemental grooves are seen radiating from the central pit.

Fig. 72* (Par. 94).—Right Upper Third Molar, Buccal Surface. The roots are not quite complete, and show the funnel-shaped openings at the apex.

Fig. 73* (Par. 94).—Left Upper Third Molar with five roots.

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* Illustration, 1½ diameters.

factorily made out. Many examples of the three-cusped teeth show much relative diminution of the disto-buccal lobe.

92. The upper third molar is the smallest of the molars,* and is more irregular in its size and conformation than the first or second molar. On account of the small size of the disto-lingual lobe, the distal portion of the tooth is much smaller than the mesial, and in the three-cusped teeth the crown becomes triangular, with its angles well rounded. (Fig. 70.)

93. The **mesial surface** resembles that in the upper first and second molars, but is more rounded, so that a concave portion is less frequent, and the distal surface is well rounded. The **lingual** and **buccal surfaces** are more rounded than the same surfaces in the other upper molars. The gingival line is usually horizontal in its course around the neck of the tooth, except that, in a few examples, there is a slight curvature on the mesial surface. Many upper third molars are much flattened from mesial to distal. These generally have a considerable concavity on the mesial surface. Occasionally teeth are found that are also abnormally small and have the appearance of supernumeraries. More rarely this tooth fails to develop, and is wanting entirely.

94. The **root** of the upper third molar has, in the more regular forms, the three divisions common to the upper molars, though relatively smaller and not so widely separated as those of the first and second molars; and often end in slender conical points; many have but a single root; but in most of these the three roots are outlined by grooves of more or less depth. A considerable number have more than three roots, which are irregular in size or form (Fig. 73). Four, five, six, and even seven or eight divisions are sometimes met. The neck is then generally broad from buccal to lingual, and the occlusal surface of the crown irregularly formed. Many of the three-cusped teeth have the root without divisions.

* Forty upper first molars balanced sixty upper third molars.

THE LOWER MOLARS.

95. The lower molars differ so much from each other, especially the first and second, that each must be separately described.

THE LOWER FIRST MOLAR.

96. The lower first molar is the sixth tooth from the median line in the lower jaw. It proximates the lower second bicuspid with its mesial surface, and the lower second molar with its distal. Next to the upper first molar, it is the largest tooth in the denture.* The outline of the **occlusal surface** (Figs. 74 and 75), when seen in a line with the long axis of the tooth, is trapezoidal, with the buccal marginal line the longest. The buccal angles are about equally acute, while the lingual angles are equally obtuse, and all are more or less rounded. The buccal margin is convex, but made irregular by two buccal grooves. The lingual margin is nearly straight, but sometimes slightly concave, or notched in the center of its length, by the lingual groove; but more generally it is slightly convex. The mesial and the distal margins are nearly straight in the best formed teeth; though the distal is sometimes considerably convex, as the fifth, or disto-lingual cusp is more or less prominent. All of these margins vary as to their convexity; the rule being that, in teeth of large size and symmetrical development, they approach nearer to straight lines.

97. Each of these marginal portions is surmounted by the mesial, buccal, lingual, and distal **marginal ridges**, which form a continuous elevation of irregular height around the margins of the occlusal surface, and on which there are five cusps. The central inclinations of these ridges form the **central fossa**. On the mesial, lingual, and distal, the summits of these ridges are close on the margins of the surface; but on the buccal, there is an inclination of the buccal surface that carries the summit of the ridge considerably toward the central axis of the tooth.

* Forty-two upper first molars balanced forty-six lower first molars.

Fig. 74.

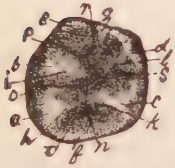

Fig. 75.

Fig. 76.

Fig. 77.

FIG. 74* (Par. 96).—LEFT LOWER FIRST MOLAR, OCCLUSAL SURFACE, of typical form. *a*, Mesio-buccal cusp; *b*, disto-buccal cusp; *c*, mesio-lingual cusp; *d*, disto-lingual cusp; *e*, distal cusp; *f*, mesial marginal ridge; *g*, distal marginal ridge; *h*, mesio-buccal triangular ridge; *i*, disto-buccal triangular ridge; *k*, disto-lingual triangular ridge; *l*, mesio-lingual triangular ridge; *m*, distal triangular ridge; *n*, mesial groove; *o*, buccal groove; *p*, disto-buccal groove; *r*, distal groove; *s*, lingual groove.

FIG. 75* (Par. 96).—RIGHT LOWER FIRST MOLAR, OCCLUSAL SURFACE. *a*, Mesio-buccal cusp; *b*, disto-buccal cusp; *c*, mesio-lingual cusp; *d*, disto-lingual cusp; *e*, distal cusp; *f*, mesial marginal ridge; *g*, distal marginal ridge; *h*, mesial triangular ridge; *i*, disto-buccal triangular ridge; *k*, mesio-lingual triangular ridge; *l*, disto-lingual triangular ridge; *n*, mesial groove; *o*, buccal groove; *p*, disto-buccal groove; *r*, distal groove; *s*, lingual groove; *t*, mesio-buccal triangular groove.

FIG. 76* (Par. 104).—LEFT LOWER FIRST MOLAR, BUCCAL SURFACE. *a*, Mesio-buccal cusp; *b*, disto-buccal cusp; *c*, distal cusp; *d*, bucco-gingival ridge; *e*, buccal pit; *f*, gingival line; *g*, mesial root; *h*, distal root; *i*, buccal groove; *k*, disto-buccal groove.

FIG. 77* (Par. 104).—LEFT LOWER FIRST MOLAR, BUCCAL SURFACE, with prominent cusps. Reference the same as for Fig. 76.

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* Illustration, 1½ diameters.

98. The **occlusal surface** has five developmental grooves (Figs. 74 and 75)—the mesial, buccal, disto-buccal, lingual, and distal—which divide it into five developmental parts, or **lobes.** These are the mesio-buccal (*a*), disto-buccal (*b*), mesio-lingual (*c*), disto-lingual (*d*), and distal (*e*), lobes; each bearing a cusp of the same name. The **mesial groove** (*n*) runs from the central fossa over the mesial marginal ridge to the mesial surface. On the mesial marginal ridge it is usually a fine line which is soon obliterated by wear. Occasionally, this is divided into two branches, with a small tubercle on the mesial marginal ridge between them (Fig. 74, *f*). In many examples there is a supplemental groove which rises from the mesial groove at about the center of its length, and runs toward the mesio-buccal angle. This is the mesio-buccal triangular groove (Fig. 75, *t*). It divides the mesial marginal ridge from the triangular ridge of the mesio-buccal cusp. More rarely there is also a similar groove running toward the mesio-lingual cusp. When these are deep, they form a mesial supplemental fossa (Fig. 75, *t*). The **buccal groove** (*o*) runs in a deep sulcus from the central pit to, and over, the buccal marginal ridge to the buccal surface, and divides the mesio-buccal from the disto-buccal cusp. The **disto-buccal groove** (*p*) also runs bucco-distally from the central pit over the buccal ridge, more or less near the distal angle, as the distal cusp is large or small. It divides the disto-buccal lobe from the distal. The **lingual groove** (*s*) runs from the central pit in a deep sulcus to, and over, the lingual marginal ridge onto the lingual surface, and divides the two lingual lobes. The **distal groove** (*r*) runs distally over the distal marginal ridge, and divides the disto-lingual lobe from the distal. Frequently this groove can be traced some distance toward the gingival line on the distal surface. The mesial and distal grooves form a line traversing the whole extent of the occlusal surface, from mesial to distal, in the center of which a **V**-shaped deflection is formed with its point to the lingual, the base receiving the point of the triangular ridge (*i*) of the disto-buccal cusp.

99. In most examples the **central fossa** occupies all the occlusal surface within the circle of the summit of the marginal ridges, though, occasionally, one or more supplemental fossæ are divided from it by high triangular ridges running down from the cusps (Fig. 75, *h, k*). The surface of the fossa is made irregular in most of these teeth by deep sulci on the lines of the grooves, separating the cusps and triangular ridges.

100. The occlusal surface of the lower first molar has **five cusps,** one on each side of the **five lobes** or three on the buccal marginal, and two on the lingual marginal ridge.* These cusps are formed by the grooves previously described (Par. 98), which pass over the ridges in depressions of variable depth, thus subdividing the crests of the ridges into obtuse elevations. Usually, these are not so high and prominent as the cusps of the upper molars. The **mesio-buccal** (Figs. 74 and 75, *a*) is the largest and strongest of the buccal cusps, and occupies rather more than one-third of the buccal marginal ridge. From its crest a triangular ridge (*h*) runs down centrally to the junction of the mesial and buccal grooves, and is divided from a similar triangular ridge from the mesio-lingual cusp, by the mesial groove. When these two ridges are high, they form, in conjunction with triangular grooves between them and the mesio-marginal ridge, a mesial supplemental fossa. The **disto-buccal cusp** (*b*) is of less extent from mesial to distal, but has a longer triangular ridge, though not so high, which ends in the point of the **V**-shaped deflection of the mesial and distal grooves, or at their junction.

101. The **lingual cusps** (*c, d*) are about equal in size and height (perhaps the mesial is a little the higher on the average). They have strong triangular ridges (*k, l*) which terminate in the angles formed by the junction of the lingual groove with the mesial and distal grooves in the central pit.

102. The **distal cusp** (*c*) occupies the distal portion of the buccal ridge, and forms the disto-buccal angle of the

*In some rare cases lower first molars have but four cusps, and then the tooth is like the lower second molar. (Pars. 109, 110.)

occlusal surface. It is the distinguishing mark of the lower first molar, being but very rarely absent in that tooth, and never present in the lower second molar. It is the smallest of the five cusps, and varies most in its relative size. In some examples it is almost or quite as large as the disto-buccal cusp. In others, especially in small and poorly developed teeth, it may be reduced to a mere tubercle, occupying the buccal portion of the distal marginal ridge and the immediate disto-buccal angle. The central incline of this cusp is commonly nearly flat, but occasionally has a rounded crest. It ends in a point at the junction of the distal and disto-buccal grooves.

103. In this tooth there is often a deep **pit** at the junction of the mesial, distal, and lingual grooves. Less frequently there is also a pit at the junction of the mesial and buccal grooves, and at the junction of the distal and disto-buccal grooves. The grooves are often **fissured** for a short distance from the pits, especially in the deeply sulcate lingual groove. In some very poorly developed teeth fissures may be found in any part of the grooves.

104. The **buccal surfaces** of the lower first molar (Figs. 76 and 77), when seen at right angles with the long axis of the tooth, is irregularly trapezoidal in form, with the occlusal margin about two-sevenths longer than the gingival. The mesial and distal margins converge toward the gingival, and the angles with the occlusal surface are about equally acute. The occlusal margin is broken into three elevations, or cusps, by the buccal and disto-buccal grooves. The gingival line is straight, or slightly curved, with the concavity toward the occlusal surface. The mesial and the distal lines are slightly convex. The buccal surface is convex in all directions; but the line of convexity from mesial to distal is broken toward the occlusal margin by the buccal and disto-buccal grooves, which pass over from the occlusal surface. The **buccal groove** (*i*) is usually a little to the mesial of the central line of the surface, and often ends in a deep pit (*e*), about half-way

from the occlusal to the gingival margin. Exceptionally, this groove is continued to the bifurcation of the root. The **disto-buccal groove** (*k*) is near the disto-buccal angle, and its course is toward the gingival line, with a distal inclination. It is usually lost to sight by becoming shallower, but in some examples it may be traced to the gingival line. The enamel terminates in a marked inclination toward the gingival line, forming the **bucco-gingival ridge.**

105. The **lingual surface** of this tooth (Figs. 78 and 79) is slightly convex in all directions. It forms a fairly sharp angle with the occlusal surface, but is rounded away toward the mesial and distal surfaces. On account of the lingual convergence of the mesial and distal surfaces, the lingual surface is much shorter mesio-distally than the buccal. The occlusal margin is deeply notched by the passage of the lingual groove (*i*), which usually terminates near the center of the surface by becoming shallower.

106. The **mesial surface** (Fig. 80) is very irregular in outline, and often the occlusal margin is deeply concave. The gingival curvature is generally marked, and the buccal and lingual marginal lines convex. The buccal margin of this surface is more convex than the lingual, and its curvature is at such an incline as to render the gingival marginal line much longer than the occlusal. The surface is slightly convex, though almost flat; but, in the central portion, near the gingival line, it is sometimes slightly concave from buccal to lingual. It is rounded away toward the mesio-buccal and mesio-lingual angles. With the occlusal surface it forms a sharp angle in the central portion, but this is rounded in its buccal and lingual portions. In the direction of the long axis of the tooth, there is usually a concavity at the junction of the enamel and cementum.

107. The **distal surface** (Fig. 81) is smoothly convex from buccal to lingual. From the occlusal surface to the gingival line it is straight or slightly convex, but forms a considerable concavity at the junction of the crown with the

Fig. 78.

Fig. 79.

Fig. 80.

Fig. 81.

Fig. 82.

FIG. 78* (Par 105).—LEFT LOWER FIRST MOLAR, LINGUAL SURFACE. *a*, Mesio-buccal cusp; *b*, disto-buccal cusp; *c*, distal cusp; *d*, mesio-lingual cusp; *e*, disto-lingual cusp; *f*, *f*, gingival line; *g*, mesial root; *h*, distal root; the roots are spread wide apart; *i*, lingual groove.

FIG. 79* (Par. 105).—LEFT LOWER FIRST MOLAR, LINGUAL SURFACE. This tooth has prominent cusps, and the roots are straight and close together. References the same as for Fig. 78.

FIG. 80* (Par. 106).—LEFT LOWER FIRST MOLAR, MESIAL SURFACE. *a*, Mesio-buccal cusp; *d*, mesio-lingual. cusp; *e*, mesial surface, point of concavity; *f*, *f*, gingival line; *g*, mesial root with broad groove.

FIG. 81* (Par. 107).—LEFT LOWER FIRST MOLAR, DISTAL SURFACE. The cusps are very prominent. *a*, Mesio-buccal cusp; *b*, disto-buccal cusp; *c*, distal cusp; *d*, mesio-lingual cusp; *e*, disto-lingual cusp; *f*, gingival line; *g*, mesial root; *h*, distal root.

FIG. 82* (Par. 108).—LOWER FIRST MOLAR, with three roots.

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* Illustration, 1½ diameters.

root, which occasionally forms a sharp angle, but generally is well rounded. The occlusal margin is often deeply notched by the distal groove. In a few examples the disto-buccal groove is deep after passing over the marginal ridge, and in its distal inclination forms a slight concavity near the disto-buccal angle.

108. The **root** of the lower first molar is divided into two prongs (Figs. 76 to 82), and this division is usually close to the crown, closer than in any other tooth in the mouth. The **mesial root** (*g*) inclines first to the mesial, and then curves regularly toward the distal. It is broad from buccal to lingual, and is much thinned from mesial to distal, so that in cross sections it measures double as much one way as the other. It is usually slightly concave on both mesial and distal surfaces, and tapers regularly, but not rapidly, from the bifurcation to the apex, and ends in a flattened but well-rounded point. The **distal root** (*h*) inclines to the distal at first, and afterward is nearly or quite straight. In some examples the apical half curves to the distal, but more often toward the mesial, so that the apexes of the two roots are inclined toward each other. It is narrower from buccal to lingual than the mesial root, and more nearly round, being but rarely concave or grooved on either mesial or distal surface. It tapers quite regularly, and more nearly to a point than the mesial root, though the apex is generally well rounded. The form of the root is regular, rarely deviating much from its type. Occasionally, however, the division of the root is incomplete. The mesial root is occasionally divided, giving the tooth three roots (Fig. 82); and I have seen a few in which the distal root was divided also, giving four roots.

THE LOWER SECOND MOLAR.

109. The most characteristic difference between the lower first and second molars is the absence of the **fifth lobe** in the second,* and the general change of form which this absence implies; the other parts of the tooth being similar.

* Since the publication of the third edition of this work three cases have been reported to me, two of which were accompanied by plaster casts in which distal lobes with cusps were observed upon the lower second molars. In all of them the cusps were small, though fairly well formed. These are certainly very rare cases.

110. When the **occlusal surface** is seen in a line with the long axis of the tooth (Fig. 83), the outline of the crown is nearly a parallelogram, with angles rounded and the lines slightly convex, the buccal most. The summits of the marginal ridges are close to the mesial, distal, and lingual margins, while the buccal is carried over toward the lingual by the inclination of the buccal surface. The central inclines of the marginal ridges form a deep central fossa, in the center of which there is usually a deep pit.

111. There are four **developmental grooves,** all arising from the central pit. The **mesial groove** (*l*) runs to the mesial margin and crosses the mesial marginal ridge as a fine line, which is often obliterated by wear. The **distal groove** (*o*) runs in a similar way to the distal surface. These two grooves divide the occlusal surface from mesial to distal, and centrally, between the summits of the buccal and lingual marginal ridges. The **buccal groove** (*m*) runs from the central pit to the buccal margin, and over it to the buccal surface, dividing the buccal ridge into two buccal cusps, while the **lingual groove** (*n*) runs to and over the lingual marginal ridge, dividing it also into two lingual cusps. The two divide the tooth from buccal to lingual, into nearly equal parts. The mesial portion is usually slightly the larger. The four grooves form a cross through the occlusal surface, dividing it into **four lobes,** or developmental parts, on each of which there is a cusp and a triangular ridge. In some examples the grooves do not exactly meet at the central pit. The lingual may rise to the mesial of the buccal, or *vice versa;* or, a similar variation may occur in the central ends of the mesial and distal, causing irregularity of the contour of the central fossa. Occasionally, the lobes are of unequal size, or the cusps are unequally developed, giving rise to imperfect forms (Fig. 84).

112. On the average, the **cusps of the lower second molar** are higher and more pointed, and the **triangular ridges** are more prominent than in the first molar. The mesio-buccal

Fig. 83

Fig. 84

Fig. 85.

Fig. 86.

Fig. 87.

Fig. 88.

Fig. 89.

FIG. 83* (Par. 110).—RIGHT LOWER SECOND MOLAR, OCCLUSAL SURFACE, of typical form. *a*, Mesio-buccal cusp; *b*, disto-buccal cusp; *c*, mesio-lingual cusp, *d*, disto-lingual cusp; *e*, mesial marginal ridge; *f*, distal marginal ridge; *g*, mesio-buccal triangular ridge; *h*, disto-buccal triangular ridge; *l*, mesio-lingual triangular ridge; *k*, disto-lingual triangular ridge; *l*, mesial groove; *m*, buccal groove; *n*, lingual groove; *o*, distal groove.

FIG. 84* (Par. 113).—RIGHT LOWER SECOND MOLAR, OCCLUSAL SURFACE, of imperfect form. *a*, Mesio-buccal cusp; *b*, disto-buccal cusp; *c*, mesio-lingual cusp; *d*, disto-lingual cusp; *e*, mesial marginal ridge; *f*, distal marginal ridge; *g*, mesio-buccal triangular ridge; *h*, disto-buccal triangular ridge; *i*, mesio-lingual triangular ridge; *k*, disto-lingual triangular ridge; *l*, mesial groove; *m*, buccal groove; *n*, lingual groove; *o*, distal groove.

FIG. 85* (Par. 115).—LEFT LOWER SECOND MOLAR, BUCCAL SURFACE. *a*, Mesio-buccal cusp; *b*, disto-buccal cusp; *c*, buccal groove; *d*, buccal pit; *f*, gingival line; *g*, mesial root; *h*, distal root.

FIG. 86* (Par. 116).—LEFT LOWER SECOND MOLAR, LINGUAL SURFACE. *a*, Mesio-buccal cusp; *b*, disto-buccal cusp; *c*, mesio-lingual cusp; *d*, disto-lingual cusp; *e*, lingual groove; *f*, gingival line; *c*, mesial root; *h*, distal root.

FIG. 87* (Par. 117).—LEFT LOWER SECOND MOLAR, MESIAL SURFACE. *a*, Mesio-buccal cusp; *c*, mesio-lingual cusp; *d*, point of proximal contact of mesial surface; *f*, gingival line; *g*, mesial root.

FIG. 88* (Par. 118).—LEFT LOWER SECOND MOLAR, DISTAL SURFACE. *a*, Mesio-buccal cusp; *b*, disto-buccal cusp; *c*, mesio-lingual cusp; *d*, disto-lingual cusp; *e*, point of proximate contact of the distal surface; *f*, gingival line; *h*, distal root.

FIG. 89* (Par. 119).—RIGHT LOWER SECOND MOLAR, LINGUAL SURFACE. The roots are curved very much to the distal.

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* Illustration, 1½ diameters.

and mesio-lingual cusps are generally a little larger than the disto-buccal and disto-lingual; also, the mesio-buccal and mesio-lingual triangular ridges (Fig. 83, *g, i*) are usually more prominent. The crests of these ridges do not run directly toward the central pit, but the two mesial ones meet mesially of the central pit, while the two distal meet distally of it. When they are high, they form **transverse ridges** by their junction, which separate a mesial and a distal supplemental fossa from the central fossa. When this occurs, there are usually triangular supplemental grooves deflected from the mesial and distal grooves, to the mesial and distal of the triangular ridges, which run toward the angles of the tooth and separate the triangular from the marginal ridges, widening and deepening the **supplemental fossæ**. A deep pit is often found at the point where these triangular grooves arise from the principal grooves. Supplemental fossæ occur much more frequently, or are more pronounced, in the mesial than in the distal portion of the tooth, but in many examples the triangular ridges are so widely divided by sulcate, mesial and distal grooves that no supplemental fossæ are seen.

113. In some examples the lower second molar presents differences in the comparative size of its **lobes**, and the grooves may be deflected from their normal course. Occasionally, the distal groove is divided, and passes over the distal marginal ridge in two divisions, with a small tubercle between them. In poorly developed teeth there may be many supplemental grooves, or wrinkles, running from the developmental grooves up onto the central inclines of the ridges and cusps.

114. **Fissures** occur oftenest near the central ends of the grooves; though they may appear in any part of their length; and in poorly developed teeth the supplemental grooves may be deeply fissured.

115. The **buccal surface** of the lower second molar (Fig. 85) is convex in all directions, except that it is partially divided into two sections, or ridges, by the buccal groove (*c*), which runs over onto it from the occlusal surface. In many,

this groove ends near the center of the surface in a deep buccal pit (*d*). This tooth has no disto-buccal groove. The mesial and distal margins converge less toward the gingival line than they do in the lower first molar. The gingival line is nearly straight, and there is a strong inclination of the border of the enamel toward it, giving the appearance of a gingival enamel ridge.

116. The **lingual surface** (Fig. 86) is similar in all points to that of the lower first molar (*q. v.*, Par. 105); but, on account of a much less convergence of the mesial and distal surfaces toward the lingual, this surface is nearly as large as the buccal surface.

117. The **mesial surface** (Fig. 87) of the lower second molar is generally a little more convex than in the lower first (*q. v.*, Par. 106); but in other respects they are similar.

118. The **distal surface** (Fig. 88) differs from that of the lower first molar in not having the distal protuberance due to the fifth cusp. Its proximating point with the tooth distal to it is usually central, or toward the lingual, instead of the buccal margin, as in the lower first molar. This surface is usually quite regularly and smoothly convex, and its gingival line seldom shows any bucco-lingual curvature.

119. The **roots** of the lower second molar (Figs. 85 to 89) are similar to those of the first molar; but the divisions are much less spread and less grooved on the mesial and distal sides. In many examples there is but a single root, which is deeply grooved on its buccal and lingual sides, marking out the divisions. The root is much more irregular in form than in the lower first molar, and is often much curved distally (Fig. 89) or otherwise distorted.

THE LOWER THIRD MOLAR.

120. The **lower third molar**, called also the wisdom tooth, or *Dens Sapientia*, is the eighth from the median line, and the last tooth in the arch. It proximates the lower second molar by its mesial surface. The tooth has **two typi-**

cal forms; the one is a four-cusped tooth, similar to the lower second molar (Fig. 83); the other a five-cusped tooth, similar to the lower first molar (Fig. 75); but there are great variations from both of these. Indeed, within the observation of the author the form of this tooth is oftener distorted than any other.

121. The **four-lobed tooth** is the more common form, and, when well developed, the occlusal surface is similar to that of the lower second molar. A supplemental fossa is often seen, formed by the prominence of the mesio-buccal and mesio-lingual triangular ridges; but in the distal portion of the crown such a fossa rarely appears. Indeed, in the four-cusped lower third molars, the distal lobes are generally much smaller than the mesial lobes.

122. The **course of the grooves** is often much distorted, so that their central ends fail to proximate, as in Fig. 90, or otherwise. This renders the form of the central fossa extremely irregular. Or the principal grooves may be so confused among a number of supplemental grooves that the real dividing lines of the lobes can scarcely be made out (Fig. 91). In many of these, some of the supplemental grooves run over the marginal ridges, corrugating them, or dividing them into several imperfect cusps. Occasionally the marginal ridges are nearly equal in height all around the margin of the central fossa, and the enamel surface of the latter is covered with small wrinkles, some of which may be deeply fissured.

123. In some instances the lower third molar is very large, and in these the ridges may be subdivided into six, seven, or eight cusps, and as many fairly distinct lobes; or, one or more **supplemental ridges** may appear within the limits of the central fossa surrounded by grooves, which divide them from other parts of the crown (Fig. 92). Such teeth are usually poorly formed, and the grooves deeply fissured.

124. The **five-lobed** lower third molars are very large teeth, larger than the second molars, and very regularly formed. The distal lobe is placed further to the distal and

lingual, and the buccal surface is more rounded than in the first molars. This form is bilateral and hereditary.

125. The **buccal surface** of the lower third molar (Figs. 93, 94, 95) is usually more convex than in the other lower molars, but otherwise of the same form. If **four-lobed** this tooth has the same grooves and pits as the lower second; if **five-lobed,** it has the markings of the lower first molars.

126. The **mesial, lingual,** and **distal surfaces** correspond with those of the other lower molars, only rather more rounded; especially the distal, which is often nearly a true circle from buccal to lingual.

127. The **root** of the lower third molar (Figs. 93, 94, 95), as compared with its crown, is usually much smaller than in the other lower molars. It may be single, or divided into two or more prongs, the tendency being to the formation of two roots, the same as in the other lower molars; and much the greater number have the root in this form, though the single root is common, and three roots (the mesial being divided) are not rare. The root, or roots, of this tooth usually curve distally, sometimes very much, and are otherwise distorted. In extracting, this inclination of the roots should be kept in mind.

THE DECIDUOUS TEETH.

128. These are the teeth of early childhood, and serve for mastication till the maxillary bones are sufficiently developed to accommodate the permanent, the larger teeth of adult age. They are then removed by **absorption** of their roots, which allows their crowns to fall away. Hence they are often called temporary teeth. The shedding process begins about the seventh year, and is completed at from the twelfth to the fourteenth, the **succedaneous** teeth taking the places of the deciduous. There are twenty deciduous teeth, ten in each jaw, namely: two **central incisors,** two **lateral incisors,** two **cuspids,** and four **molars.** This may be expressed by the following formula:

$$\text{I } \tfrac{2}{2}\ \text{C } \tfrac{1}{1}\ \text{M } \tfrac{2}{2} = 20$$

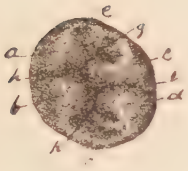

Fig. 90.

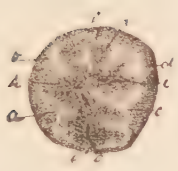

Fig. 91.

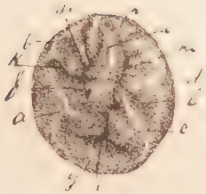

Fig. 92.

Fig. 93.

Fig. 94.

Fig. 95.

Fig. 90* (Par. 122).—Left Lower Third Molar, Occlusal Surface, imperfect form. *a*, Mesio-buccal cusp; *b*, disto-buccal cusp; *c*, mesio-lingual cusp; *d*, disto-lingual cusp; *e*, mesial marginal ridge; *f*, distal marginal ridge; *g*, mesial groove, *h*, buccal groove; *i*, lingual groove; *k*, distal groove. The buccal and lingual grooves do not meet in the central fossa as in regular forms.

Fig. 91* (Par. 122).—Lower Third Molar, Occlusal Surface, very imperfect form. *a*, Mesio-buccal cusp; *b*, disto-buccal cusp; *c*, mesio-lingual cusp; *d*, disto-lingual cusp; *e*, mesial marginal ridge; *f*, distal marginal ridge; *g*, mesial groove; *h*, buccal groove; *i*, lingual groove; *k*, distal groove. Several of the grooves are fissured and are irregular in form.

Fig. 92* (Par. 123).—Right Lower Third Molar, Occlusal Surface, very large and irregular in form. *a*, Mesio-buccal cusp; *b*, a very imperfect disto-buccal cusp; *c*, mesio-lingual cusp, with a sharp triangular ridge, running very much to the distal; *d*, disto-lingual cusp, standing very much to the mesial of its proper position; *e*, *f*, a large supplemental ridge, occupying the middle portion of the central fossa; *g*, mesial marginal ridge; *h*, distal marginal ridge; *i*, mesial groove, deeply fissured and with supplemental grooves, also fissured, extending to the labial and lingual, forming a supplemental mesial fossa; *k*, buccal groove; *l*, lingual groove; *m*, *n*, deep fissure on either side of the supplemental ridge. There are a number of deep wrinkles running over the distal marginal ridges.

Fig. 93* (Par. 125).—Right Lower Third Molar, Buccal Surface, with five cusps. *a*, Mesio-buccal cusp; *b*, disto-buccal cusp; *c*, buccal groove; *d*, buccal pit; *e*, disto-buccal groove; *f*, distal cusp; *g*, gingival line; *h*, mesial root; *i*, distal root. In this tooth the distal root is the larger, and the two come together at their apexes, each of which is unusual.

Fig. 94* (Par. 127).—Right Lower Third Molar, with the roots curved very much to the distal.

Fig. 95* (Par. 127).—Left Lower Third Molar, Buccal Surface; three roots. *a*, Mesio-buccal cusp; *b*, disto-buccal cusp; *c*, distal cusp; *d*, buccal groove; *f*, gingival line; *g*, mesial root; *h*, distal root; *i*, supernumerary root.

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* Illustration, 1½ diameters.

There are no **bicuspids** in the deciduous set, and therefore the deciduous first molars proximate directly with the deciduous cuspids. The bicuspids of the permanent set are succedaneous to the deciduous molars.

129. The **incisors** and **cuspids** of the deciduous set are (Figs. 96 to 101) similar in form and lobal construction with their succedaneous teeth, but the **deciduous molars** give place to the **permanent bicuspids,** which are of very dissimilar pattern. The **deciduous second molars** (Figs. 103, 105), both upper and lower, are of the same form and lobal construction as the permanent first molars. The **deciduous first molars,** upper and lower, have no similar teeth in the permanent set. Their form and the arrangement of their **lobes** are peculiar to themselves; therefore, the crowns of these will be separately described. (Pars. 134 to 150.)

130. Though the **crowns** of the temporary teeth are, with the exceptions mentioned, of similar form and lobal construction as the permanent, there are certain minor differences which distinguish them. They are considerably smaller than the corresponding permanent teeth. This reduction in size includes the whole tooth, and is such that it leaves the general proportions unchanged, except that the roots are proportionally longer.

131. The deciduous teeth are, however, marked with a much greater **constriction at their necks.** The enamel, instead of thinning away to the gingival border as in the permanent teeth, retains its thickness almost to the gingival line and terminates abruptly, leaving a sudden constriction of the neck of the tooth. This varies in degree, but is common to all of the deciduous teeth, and distinguishes them from the permanent teeth.

132. The **buccal** and **lingual surfaces** of the deciduous molars are inclined toward the occlusal surface much more than those of the permanent, so that the immediate occlusal surface is narrow in proportion to the greatest bucco-lingual thickness of the crown. This gives the crown as seen in the

mouth the appearance of being very long from mesial to distal; though this characteristic is less marked in the upper than in the lower deciduous molars (see Figs. 106 and 107).

133. The **enamel** of the deciduous teeth is usually whiter than that of the permanent teeth, and they are probably of coarser texture. The difference in color is often strongly contrasted when some of the permanent teeth, as the central incisors, have taken their places by the sides of the remaining temporary teeth.

UPPER FIRST DECIDUOUS MOLAR.

134. The **occlusal surface** of the upper first deciduous molar (Fig. 107), when seen in the line of the long axis of the tooth, presents an irregular quadrangular form in which the buccal marginal line is the longest. The mesio-buccal angle is acute, the mesio-lingual is obtuse, and both distal angles are nearly right angles. The buccal margin is irregularly convex, and the lingual margin regularly rounded. Both the buccal and lingual surfaces are much inclined centrally, or toward the occlusal surface.

135. This tooth has **three lobes,** divided by **three grooves.** The mesial (*a*) and distal (*b*) grooves run from the mesial to the distal margin in a deep sulcus, and divide the lingual from the buccal lobes. Their junction is in a pit in the central fossa. The buccal groove (*c*) rises from the same pit, at the junction of the mesial and distal grooves, and runs over the buccal marginal ridge to the buccal surface. This groove is generally without a sulcus; or, at most, there is but a slight furrow.

136. The **buccal marginal ridge** is a high cutting edge which rounds up from the mesio-buccal angle of the occlusal surface and runs to the distal and buccal till it reaches the point of the mesio-buccal cusp (*d*). Its direction is then to the distal, descending slightly to the buccal groove, then horizontally to the disto-buccal angle to join the distal marginal ridge, the latter portion forming a small disto-buccal cusp (*e*).

Fig. 96.

Fig. 97.

Fig. 98.

Fig. 102.

Fig. 103.

Fig. 99.

Fig. 100.

Fig. 101.

Fig. 104.

Fig. 105.

Fig. 106.

Fig. 107.

Fig. 96* (Par. 129).—Deciduous Upper Central Incisor.
Fig. 97* (Par. 129).—Deciduous Upper Lateral Incisor.
Fig. 98* (Par. 129).—Deciduous Upper Cuspid.
Fig. 99* (Par. 129).—Deciduous Lower Lateral Incisor.
Fig. 100* (Par. 129).—Deciduous Lower Lateral Incisor.
Fig. 101* (Par. 129).—Deciduous Lower Cuspid.
Fig. 102* (Par. 138).—Left Upper First Deciduous Molar, Buccal Surface. *a*, Bucco-gingival ridge; *b*, mesio-buccal cusp; *c*, disto-buccal cusp; *d*, buccal ridge; *e*, buccal groove.
Fig. 103* (Par. 129).—Left Upper Second Deciduous Molar.
Fig. 104* (Par. 148).—Left Upper First Deciduous Molar, Buccal Surface. *a*, Bucco-gingival ridge; *b*, mesio-buccal cusp; *c*, disto-buccal cusp; *d*, buccal ridge; *e*, buccal groove.
Fig. 105* (Par. 129).—Left Lower Second Deciduous Molar, Buccal Surface.
Fig. 106* (Par. 141).—Lower First and Second Deciduous Molars, Occlusal Surfaces. The lobes and grooves of the lower second deciduous molar are the same as those of the permanent lower first molar, Fig. 75. The lower deciduous first molar has four lobes. *a*, Mesial groove; *b*, buccal groove; *c*, lingual groove; *d*, distal groove; *e*, mesio-buccal cusp; *f*, disto-buccal cusp; *g*, mesio-lingual cusp; *h*, disto-lingual cusp; *i*, mesial fossa.
Fig. 107* (Par. 134).—Left Upper First and Second Deciduous Molars. The second deciduous molar has its grooves and holes in the same form as those of the first permanent molar, Fig. 54. The upper first deciduous molar has but three cusps. *a*, Mesial groove; *b*, distal groove; *c*, buccal groove; *d*, mesio-buccal cusp; *e*, disto-buccal cusp; *f*, lingual cusp.

* Illustration, 1½ diameters.

In unworn teeth, the buccal groove causes a marked, but slight, depression where it crosses the ridge, breaking it into two cusps; the mesial being the larger and more pointed. This division is generally defaced very early by wear, so that the ridge presents an almost straight rounded edge.

137. The **lingual cusp** (*f*) is in the form of an elevated crescentic edge with its convexity to the lingual, which runs from the mesial termination of the mesial groove (*a*) to the distal termination of the distal groove (*b*). The central and the lingual inclines of this cusp are nearly equal slopes, while the buccal incline toward the buccal marginal ridge is less abrupt than the central. The mesial and distal marginal ridges are not marked by more than a very slight thickening of the enamel, and are cut through by the mesial and distal grooves.

138. The buccal surface (Fig. 102) is remarkable for its **bucco-gingival ridge** (*a*), which stands boldly out from the gingival line from one to three millimeters and extends from the mesio-buccal to the disto-buccal angle of the tooth. At the mesio-buccal angle it terminates abruptly in a marked prominence, and diminishes gradually as it passes to the disto-buccal angle.

139. From the summit of the bucco-gingival ridge to the summit of the buccal marginal ridge, or the mesio-buccal cusp, is nearly a flat surface, except a slight depression along the buccal groove. In many examples there is a slight concavity extending from mesial to distal along the occlusal margin of the bucco-gingival ridge, and from the point of the mesio-buccal cusp a strong ridge runs to the mesio-buccal prominence of the bucco-gingival ridge.

140. The **mesial** and **distal surfaces** are quite smoothly flattened. The lingual surface is convex. The neck presents the characteristic constriction common to deciduous teeth.

LOWER FIRST DECIDUOUS MOLAR.

141. The **occlusal surface** of the lower first deciduous

molar (Fig. 106), when viewed in a line with the long axis of the tooth, presents the outline of a parallelogram, modified by the rounding of its angles and more or less convexity of its lines. In many, the distal portion is broader than the mesial, giving the tooth an ovoid outline. There are two **fossæ.** The principal fossa occupies nearly three-fourths of the distal portion of the surface, while the small mesial fossa occupies the immediate mesial portion.

142. The tooth has **four lobes** of irregular form, divided by four grooves. These grooves all run from the principal fossa. The **mesial groove** (*a, a*) rises from the central pit and runs to the mesial, passing over the transverse ridge into the mesial fossa, where it is deflected sharply to the lingual, passing over the marginal ridge near the mesio-linguo-occlusal angle. This groove varies considerably in its course in different examples. In the principal fossa it usually inclines to the buccal and then toward the lingual, but there is generally an angle at the origin of the buccal groove. The **buccal groove** (*b*) rises from the mesial groove, some distance to the mesial of the pit, and runs over the buccal ridge onto the buccal surface, in a slight sulcus, dividing the buccal marginal ridge into two cusps, the mesio- and disto-buccal. Its position determines the relative size of the buccal lobes. The **lingual groove** (*c*) runs from the central pit over the lingual marginal ridge onto the lingual surface, and is deeply sulcate on the central incline of the ridge. The **distal groove** (*d*) arises from the central pit and runs over the distal marginal ridge nearly centrally, to the distal surface. It is often deflected to the buccal in the first part of its course by the point of the disto-lingual triangular ridge.

143. This tooth has **four cusps** corresponding with the four lobes. The mesio-buccal lobe (*e*) is very irregular in its outline. It forms the entire mesial marginal ridge, and from one-third to three-fourths of the slopes of the mesial fossa. The **mesial marginal ridge** is usually high in young, unworn teeth. It is curved, and from the mesio-bucco-occlusal

angle of the tooth it becomes the buccal marginal ridge, and rises to the distal to form the point of the mesio-buccal cusp (*e*). From the point of the cusp it falls away to the distal and buccal to the buccal groove. A prominent **triangular ridge** descends from this cusp to the lingual and distal, and joins a similar triangular ridge from the mesio-lingual cusp (*g*) to form the **transverse ridge**, thus dividing the mesial from the principal fossa. Exceptionally, a deep sulcus divides these triangular ridges and connects the fossæ. From the buccal groove, the buccal marginal ridge passes almost directly to the disto-bucco-occlusal angle where it joins the distal marginal ridge. In the central portion it rises slightly to form the low disto-buccal cusp (*f*). The triangular ridge from this cusp is usually low, or wanting.

144. The **lingual marginal ridge** (*g, h*) rises abruptly from the mesial groove to the summit of the mesio-lingual cusp (*g*), and then falls away toward the distal and lingual to the lingual groove. In most specimens, in unworn teeth, the mesio-lingual cusp is sharp, and its point is carried by the lingual incline far toward the central line of the tooth, so much so as to be in marked contrast with the general form of the lingual cusps of the lower molars. From its apex a **triangular ridge** descends to join that from the mesio-buccal cusp in forming the transverse ridge. From the lingual groove, the lingual marginal ridge rises to the point of the disto-lingual cusp (*h*) and then falls away in a curve to form the distal marginal ridge. This cusp is generally rather low, but varies much in these teeth. In some cases there is a sharp triangular ridge descending into the central fossa, but more generally this ridge is slight.

145. The **distal marginal ridge** is usually made to appear prominent by the depth of the principal fossa. It is crossed near its center by the distal groove.

146. The **principal fossa** is generally deep and well rounded. The distal triangular ridges, the only ones descending into this fossa, are generally not prominent, but occasion-

ally they are sufficiently so to render the fossa very angular. I have observed many in which the enamel in this fossa was very imperfect and the bottom of the fossa broad and rough.

147. The **mesial fossa** (*i*) is usually sharp and deep, with smooth inclines, and has a central pit that is frequently the seat of caries.

148. The **buccal surface** of the lower first deciduous molar (Fig. 104) is remarkable for its prominent **bucco-gingival ridge** (*a*), which runs from the mesial to the distal margin and stands out prominently over the junction of the crown with the root. From mesial to distal, this ridge slopes toward the occlusal surface, making the crown longer at the mesio-buccal angle than at the disto-buccal. From this ridge the surface slopes rapidly toward the occlusal margin, and more rapidly at the mesial than the distal portion. From the mesio-buccal cusp a strong ridge of enamel runs to the more prominent portion of the bucco-gingival ridge near the mesio-buccal angle of the tooth. Otherwise this surface is nearly flat. The **lingual surface** is usually well rounded, but is broken toward the occlusal surface by the prominence of the mesio-lingual cusp, and the sulcus of the lingual groove.

149. The **mesial** and **distal surfaces** are slightly rounded. The disto-buccal and disto-lingual angles of the tooth are about equal in prominence, but the mesio-buccal and mesio-lingual angles are very unequal. The mesial surface slopes rapidly to the lingual, making the lingual surface much shorter, mesio-distally, than the buccal. The mesio-buccal angle is acute and prominent, while the mesio-lingual is very obtuse and rounded.

150. The **root** of this molar is divided into two prongs, which are spread widely apart. They are thin from mesial to distal, and slightly grooved; and, from buccal to lingual, broad. They taper regularly to broad, flat apexes, which are occasionally bifurcated a short distance.

151. The roots of the deciduous teeth are the same in number and general characteristics as in the teeth of the same

denomination in the permanent set, except that those of the molars are more divergent. This spreading of the roots accommodates the crowns of the permanent bicuspids, which are developed between the roots of the deciduous molars. Those of the lower jaw are thin from mesial to distal, broad from buccal to lingual, and grooved along their flattened sides. The mesial and distal roots of the upper deciduous molars are also thin, grooved, and widely divergent. The lingual root stands boldly to the lingual, forming a wide space between the three, for the crowns of the upper bicuspids. In many examples the lingual and distal roots are joined by broad thin connections for the greater part of their length.

THE PULP CHAMBER.

152. **Every tooth** has a cavity in the center of the crown, and one or more canals extending through the long axis of the root, or roots, to the apex. This cavity contains a tissue composed of cellular elements imbedded in a semi-gelatinous matrix, filling every part of the space, and is richly supplied with blood-vessels and nerves. This is known as the **pulp of the tooth.***

153. The **central cavity** in the tooth is usually divided into a crown, or coronal portion, and a root portion. Its parts are familiarly known as the **pulp chamber** (crown cavity), and **root canal**, or root canals. The pulp chamber is comparatively large, and the root canals are small, tapering from the pulp chamber to a minute opening at the apex of the root, known as the **apical foramen.** In those teeth that have prominent cusps, as the bicuspids and molars, there is a prolongation of the pulp toward the point of each cusp. These are known as the **horns** of the pulp; and the prolongations of the chamber are designated the horns of the pulp chamber.

154. The **size** of the pulp chamber and of the root

* As the form of the pulp chamber gives the exact form of the pulp, no separate description of the pulp will be given. It is not my purpose to give any histological descriptions in this work.

canals varies greatly in teeth of different denominations; and also in different teeth of the same denomination. In the early formative stages of the teeth it is very large, and diminishes in size as growth proceeds, until the tooth is fully formed. Afterward this diminution goes on slowly, until, in old age, it is often nearly obliterated. In the formative stage, *i.e.*, during the growth of the root of the tooth, the root canal is large and **funnel-shaped,** with the open end of the funnel toward the apex of the root(Fig. 72). As growth proceeds, and the root approaches completion, this diminishes rapidly till the root is fully formed, when it is contracted to a small foramen. This, however, continues to diminish slowly. Therefore, the size of the pulp chamber, the root canals, and the apical foramen, are greater in youth than in old age. However, after adult age is reached, the diminution in size is usually not great. During this time, the horns of the pulp chamber are shortened by the same process of formation of dentine on their surface that is going on in all parts of the pulp chamber and root canal. Therefore, the horns of the pulp become shorter, or recede, as age advances. Indeed, the whole pulp, very slowly, becomes smaller.

155. **Certain processes,** when present, also serve to diminish the size of the pulp chamber more rapidly; especially abrasion of the teeth, a matter that seems to depend largely upon the character of the occlusion. When the occlusion is such that there is much rubbing, or sliding motion, of the teeth against each other, wear goes on rapidly. This seems to induce depositions of dentine on the walls of the pulp chamber, which reduces its size; and, especially, causes the recession of the horns of the pulp. In this way, exposure of the pulp from the wearing away of the dentine is delayed or prevented. In many instances the pulp chamber is almost obliterated in the molars and bicuspids, and recedes rootwise of the gingival line in the incisors and cuspids. Slowly progressive caries or erosion of the teeth often induce similar deposits.

156. In the **incisors** and **cuspids,** the pulp chamber and

the root canal are not sharply differentiated. The latter tapers, gradually, from the full size of the largest crown portion to a small foramen at the apex of the root. In teeth with more than one root, the transition from pulp chamber to root canal is usually sharply defined, the former being very large as compared with the pulpal end of the latter. Indeed, the general form of the pulp is a diminished counterpart of the form of the surface of the tooth, except that it is in every way more slender.

157. Our studies thus far have been of the outer surfaces of the teeth. The pulp chambers are within, and, therefore, in the study of them, dissections must be made to expose them to view. It is often necessary for the dentist to enter the pulp chambers of the teeth of his patients, and there perform delicate operations with a precision which demands the most accurate knowledge of these cavities. Therefore this work of exposure, and examination, of the pulp chambers of teeth should be thorough, as a preparation for operations in the mouth. The form of dissection necsesary will be given in connection with the teeth as they are individually described.

THE PULP CHAMBERS OF THE UPPER INCISORS.

158. The pulp chambers and root canals of the upper central and lateral incisors are so similar, the description of one will do for all.

Dissection.—1st. Saw the tooth through on the gingival line, at the labial surface, at right angles with the long axis.

2d. Saw the tooth from labial to lingual, along the central line of the long axis from end to end.

3d. Saw the tooth from mesial to distal, along the central line of the long axis from end to end.

159. A very thin saw in a strong frame should be used, otherwise the lengthwise dissections should be made to one side of the central line in their first instance, and afterward the whole length of the pulp chamber exposed by grinding on a stone; or the lengthwise exposure may be made by catching the tooth in the vise and removing one-half with the file, or by

grinding on an emery wheel. After the pulp chamber is exposed so that half of its concavity remains in the half of the tooth, and has been ground smooth and flat, it should be inked on an inked pad (such as is used for the rubber stamps for printing), and a print made from it. This will give the form of the tooth and pulp chamber in silhouettes similar to the accompanying illustrations. The printing is facilitated by sticking the tooth to a piece of hard wax for convenience in handling. Ordinary modeling compound, or sealing wax, is convenient and effective.* The printing is usually better done by laying ordinary writing paper on a sheet of semi-soft rubber, about one-eighth inch in thickness. This is specially useful when the ground surface cannot be perfectly flat, as in curved roots.

160. In the **upper central** and **lateral incisors** (Figs. 108 and 109) there is no distinct division of the pulp cavity into pulp chamber and root canal; but there is one straight canal, from the interior of the body of the crown to the apex of the root, of which the crown portion is the larger. In young teeth, this has very distinctly the form of the surface of the tooth and root, except that it is much more slender. The largest diameter of the cavity is about level with the gingival line on the labial surface. From this point, the pulp chamber, or canal, extends toward the cutting edge of the tooth, about two-thirds the length of the crown, sometimes a little more, often less, and ends in a thin edge, broad from mesial to distal. In young teeth this edge has three short horns (Fig. 108, *a*, *b*), or prolongations, extending toward the three small cusps, or mammelons, seen on the edge of unworn incisors (21).

161. From the level of the gingival line toward the apex of the root it tapers very gradually and regularly to a narrow canal. Just within the apex of the root, almost at the end, there is usually a sudden contraction of the diameter of the canal, lessening it from one-third to one-half. This is the

*Dr. Cattell has found that in teaching it is very convenient to have a sufficient number of small pine blocks ($\frac{3}{4}$ x $\frac{3}{4}$ x 1 inch) to which he has pupils cement the teeth with sealing wax.

Fig. 108

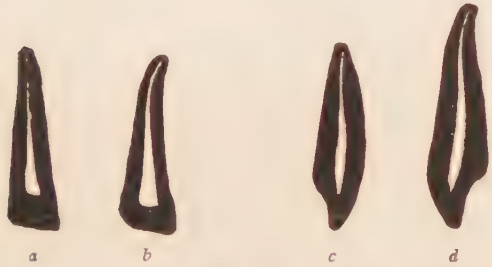

Fig. 109

Fig. 110.

Fig. 108* (Par. 160).—The Pulp Chamber of the Upper Central Incisor. *a*, *b*, Mesio-distal sections of young teeth, showing the three short horns of the pulp; *c*, mesio-distal section of a tooth from an adult; *d*, *e*, labio-lingual sections.

Fig. 109* (Par. 160).—Pulp Chamber of the Upper Lateral Incisor. *a*, *b*, Mesio-distal sections; *c*, labio-lingual sections; *d*, labio-lingual section of a very long lateral incisor.

Fig. 110* (Par. 163).—Pulp Chamber of the Upper Cuspids. *a*, *b*, Mesio-distal sections; *c*, *d*, labio-lingual sections.

* Illustration, actual size.

apical foramen; but this contraction of the canal is not usually present for one or two years, or more, after the tooth has taken its place in the arch (*q. v.*, Par. 154).

162. The canal becomes smaller from youth to old age. In incisors just taking their places in the arch, I have found the diameter of the canal at the gingival line to be from one-fourth to one-third the diameter of the neck of the tooth. In early adult age, the canal may be said to average about a fourth the diameter of the neck of the tooth, ranging down as age advances to one-fifth, or sixth, and even to one-tenth. In the lateral incisor, the chamber and canal are a little smaller than in the central, but larger in proportion to the size of the tooth.

THE UPPER CUSPID.

163. The pulp chamber and root canal of the **upper cuspid** (Fig. 110) is about the same in form as that of the central and lateral incisors, except that the coronal extremity has the central horn much extended toward the apex of the cusp of the tooth, and the mesial and lateral horns are practically absent. The canal is proportionately somewhat smaller. However, this tooth is often somewhat flattened at the neck, the long diameter being from labial to lingual. In this case the pulp canal at the neck, and from thence toward the apex of the root, is also much flattened in the same direction, but is progressively rounded as the apex is approached. In some examples, the labio-lingual diameter of the canal is double the mesio-distal. As age advances, and the canal becomes smaller, the opening is occasionally reduced to a mere slit.

PULP CHAMBER OF THE LOWER INCISORS.

164. (Fig. 111.) The **coronal portions** of the pulp chamber of the **lower incisors** are much flattened. At the level of the gingival line, the long diameter is from labial to lingual. The chamber extends toward the cutting edge of the tooth, about two-thirds the length of the crown, and in this extension its diameter is progressively diminished from labial to lingual, and extended from mesial to distal, follow-

ing the contour of the surface of the tooth, and ends in a thin edge. In young teeth this has three short projections toward the mammelons on the cutting edges of the young, unworn teeth. The **root** has usually a narrow slit-like opening for the greater portion of its length (*d, g*), corresponding with the form of the flattened roots. In many instances, however, the root canal is divided into two portions, or canals, for a part of its length (*e, f*). In the adult these canals are usually very small. The point of separation into two canals is irregular, but is usually slightly root-wise from the level of the gingival line. It may occur at about the level of the gingival line, or the canal may remain single for half the length of the root, and then be divided for a space, the two uniting again before reaching the apex. Generally, there is but one apical foramen. Instances occur in which there are two, each canal remaining distinct to the end. As age advances, the canals of the lower incisors often become very minute.

PULP CHAMBER OF THE LOWER CUSPID.

165. The pulp chamber and the root canal of the **lower cuspid** (Fig. 112) are variable in size and form. At the neck of the tooth the chamber is usually irregularly flattened, with the longer diameter from labial to lingual, and the labial portion wider than the lingual. The **coronal portion** extends about two-thirds of the length of the crown toward the point of the cusp, ending in a point, or horn, which is often very slender. The form of the **root portion** of the canal depends on the form of the root. It is sometimes nearly round, but more frequently it is sharply flattened for the greater portion of its length, becoming more rounded toward the apex. Occasionally, this canal is divided for a part of the length of the root. Also, the root is sometimes divided, a very small prong appearing on its lingual side. In this there is usually a very small canal that is difficult to enter with a broach. In some lower cuspids the canal is very small (*a*), in others very large (*b*). In a few instances I have seen it more than one-third the

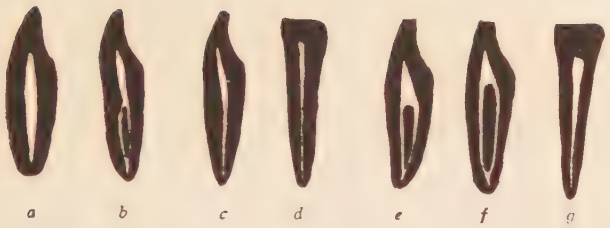

Fig 111.

Fig. 112.

FIG. 111* (Par. 164).—PULP CHAMBER OF THE LOWER CENTRAL AND LATERAL INCISORS. *a, b, c,* Labio-lingual sections, showing differences of form of the pulp chamber; *d,* mesio-distal section: *e, f,* labio-lingual sections, showing the more usual forms of the pulp chamber; *g,* mesio-distal section, showing a large pulp chamber.

FIG. 112* (Par. 165).—PULP CHAMBER OF THE LOWER CUSPIDS. *a,* Labio-lingual section, showing a small chamber; *b,* labio-lingual section, showing a very large pulp chamber; *c,* mesio-distal section.

* Illustration, actual size.

diameter of the root in the adult. In this case the diameter of the canal is greater than the thickness of the walls of dentine and cementum by which it is inclosed. This renders the pulp very liable to exposure in excavating carious cavities.

PULP CHAMBERS OF THE BICUSPIDS.

166. *Dissections.*—1st. Divide the crown from the root on the gingival line with a fine saw.

2d. Divide the tooth from buccal to lingual through its length with a fine saw, or remove the distal half of the tooth with the file or stone. These two dissections will usually exhibit the pulp chamber and root canals sufficiently, though in the single-rooted teeth with two canals it is better to divide the root crosswise at the middle of its length, or at several points.

PULP CHAMBER OF THE UPPER FIRST BICUSPID.

167. The pulp chamber and root canals of this tooth differ from those of the incisors and cuspids by having the **coronal chamber** distinguished sharply from the **root canals** (Fig. 113, *d*, *e*). The chamber is centrally located in the long axis of the crown of the tooth, the axial walls being about equal in thickness. The center of the pulp chamber is about level with the gingival line, or a little toward the occlusal surface. The occlusal walls are thicker than the axial, and vary in thickness from one-third to two-thirds of the length of the crown of the tooth. The form of the pulp corresponds closely with the form of the tooth. A **horn** extends from the coronal portion toward the apex of each cusp. The **buccal horn** rises from the extreme buccal part of the pulp, while the **lingual horn** rises from the extreme lingual portion. Sometimes, especially in teeth with long cusps, they are very long and slender, extending far toward the points of the cusps, and in rare cases almost, or even quite, to the enamel. As age advances, they become shorter, and in old age have almost disappeared. In thick-necked teeth with short cusps

the horns of the pulp chamber are short, and the occlusal wall is usually very thick.

The **root canals** in upper first bicuspids that have two roots pass from the pulp chamber through the center of each root to its apex, and are known as the buccal and lingual root canals (*c*). The **buccal canal** rises from the extreme buccal side of the pulp chamber, and the **lingual canal** from the extreme lingual side, and their course is almost parallel with the walls of these two portions of the pulp chamber. The floor of the chamber is rounded over in an arch from one canal to the other. Each canal begins in a funnel-shaped opening leading into a narrow round canal, which tapers gradually to the apical foramen. Many of the upper first bicuspids have only one root; but they generally have two root canals almost exactly similar to those with two roots. Occasionally, however, these come together and end in one apical foramen, or there may be a communication between the two canals in some part of their course (*d*). More rarely, the upper first bicuspid has one broad (from buccal to lingual), flat canal passing through the whole length of its single root. Sometimes this is divided near the apex (*b*).

PULP CHAMBER OF THE UPPER SECOND BICUSPID.

168. The **pulp chamber** of the upper second bicuspid (Fig. 114) is similar to that of the first (*q. v.*, Par. 167), but the horns of the pulp are usually shorter. In this tooth there is generally but a single root canal (*e, f*). This is approached by an opening that is broad bucco-lingually, and tapers gradually toward the apex of the root, ending in a narrow apical foramen. The canal is often quite large, and the demarkation of the pulp chamber, as distinguished from the root canal, very indistinct, or entirely absent. Examples are not infrequent, however, in which there are two root canals in the single root (*d*). They are then similar to those of the first bicuspid; but, sometimes, the two canals end in a common apical foramen (*a*).

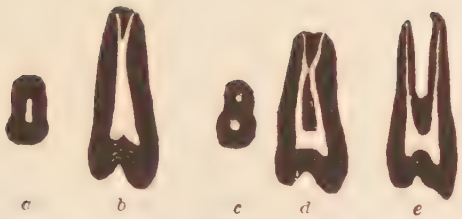

Fig. 113.

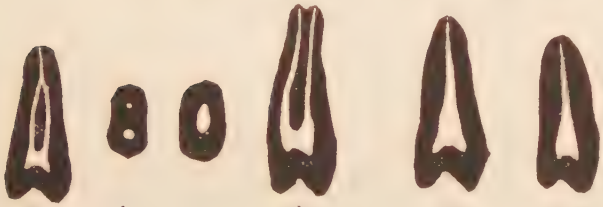

Fig. 114.

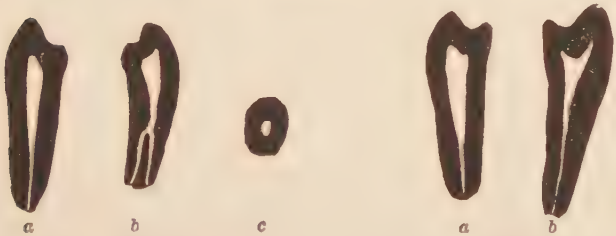

Fig. 115. Fig. 116.

FIG. 113* (Par. 167).—PULP CHAMBER AND ROOT CANALS OF THE UPPER FIRST BICUSPIDS. *b*, Bucco-lingual section of single-rooted tooth, with single canal divided near the apex of the root; *a*, cross-section of the same, mid-length of the root; *d*, bucco-lingual section of a single-rooted tooth with two canals, which connect at one point; *c*, cross-section of the same, a little rootwise from the pulp chamber; *e*, bucco-lingual section of double-rooted tooth, showing the more usual form of the chambers and canals.

FIG. 114* (Par. 168).—PULP CHAMBER AND ROOT CANALS OF THE UPPER SECOND BICUSPID. *a*, Bucco-lingual section, showing chamber with long, slender horn, also two canals, which unite in the apical third of the root; *b*, cross-section of a root with two canals; *c*, cross-section of a root with a single large canal; *d*, bucco-lingual section of a single root with two canals; *e*, *f*, bucco-lingual sections, showing the more usual form of the pulp chamber and root canal of this tooth.

FIG. 115* (Par. 169).—PULP CHAMBER AND ROOT CANALS OF THE LOWER FIRST BICUSPID. *a*, Bucco-lingual section, showing the more usual form; *b*, bucco-lingual section, showing a peculiar and very unusual division of the root canal; *c*, cross-section in the body of the root.

FIG. 116* (Par. 169).—PULP CHAMBER AND ROOT CANAL OF THE LOWER SECOND BICUSPID. *a*, *b*, Bucco-lingual sections, showing the more usual forms of the chamber and canal in this tooth.

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* Illustration, actual size.

PULP CHAMBERS OF THE LOWER BICUSPIDS.

169. The **pulp chambers** of the lower bicuspids (Figs. 115 and 116) seldom show a marked distinction from the root canals. There is, however, usually a coronal bulbous portion which connects with the pulp canal proper by an extended funnel-shaped constriction (*a*, *b*). In the **lower first bicuspid** the coronal extremity ends in a horn, which extends toward the point of the buccal cusp. This horn may be short and obtuse, or long and pointed. There is, generally, a well-marked protrusion toward the lingual cusp, but no extended horn. It is rather an enlargement of the bulb in that direction. In the **lower second bicuspid** this protrusion is more considerable, and in some examples it is elongated into a slender point, especially in young teeth (Fig. 116, *b*). In the three-cusped lower second bicuspids (Par. 62, Fig. 49) there are two of these on the lingual side, spreading toward the mesial and distal. They are generally short, but by their protrusion are brought rather nearer the surface of the tooth than other horns of the pulp, and are, therefore, more liable to be opened into when excavating proximate cavities.

170. The **root canals** of the lower bicuspids are usually large in the first half, tapering to a fine canal in the apical third, of their length. The canal of the lower first bicuspid is usually nearly round, and that of the second is considerably flattened; and in both they are usually straight. Bifurcations of these canals are rare, but occur occasionally. In the illustrations (Fig. 115, *b*) one is shown dividing in such a way that the division would not be likely to be detected by a broach.

PULP CHAMBERS OF THE UPPER MOLARS.

171. *Dissections.*—1st. With a fine saw, separate the crown from the root level with the gingival line.

2d. Cut away the mesial surface of the crown and the mesial surface of the mesial and lingual roots with the file or a corundum stone, till the canals in each are fully exposed.

As the mesial root is generally curved, some care is required to fully expose the full length of the canal without cutting too far in the central portion of its length. If the curved surface is made smooth, good prints can generally be made by using a piece of semi-soft rubber under the paper, and, while pressing it to the paper, rolling the tooth so as to bring all of the length of the curved surface in contact.

3d. Cut away the buccal surface so as to expose the pulp chamber and canals of the two buccal roots, observing the same precautions as in the second dissection.

In the first dissection both crown and root should be examined. First, clean the portion of the chamber in the crown, to study carefully its horns and its general shape or contour with relation to the outer surface of the tooth. The root canals should be cleaned with the broach, and their size and direction carefully studied; also, the position of the openings leading from the pulp chamber should be studied with regard to their relation to the several points of the surface of the crown. This latter is especially important. Several dissections should be made of each of the upper molars.

4th. Grind away the root portion of the first dissection, printing occasionally till the bifurcation of the roots is reached.

172. The **pulp chamber** of the upper molars is very distinct from the pulp canals, the latter often leaving the former by very small openings (Fig. 117). The average diameter of the pulp chamber is about equal to the thickness of the axial wall by which it is surrounded, sometimes more, sometimes less. The occlusal wall is usually considerably thicker. The form of the pulp chamber is generally similar to that of the crown of the tooth; but the **horns** in the young tooth are often quite slender as compared with the cusps, and penetrate far toward the enamel. The length of these diminishes as age advances. In teeth much flattened mesio-distally, as often occurs in the upper first molars, and especially with the second, the equal thickness of the axial walls is usually maintained pretty closely, so that the flattening of the pulp chamber seems out of proportion to the form of the tooth.

173. The **floor** of the pulp chamber is rounded or arched in the center, and falls away toward the mouths of the canals. The latter are situated in the position of the **angles of a triangle** (*the molar triangle*, Figs. 118 and 119), the mesial line of which is the longest, the buccal the shortest, and the distal the intermediate length. For the **upper first molar,** this triangle is well shown in the illustrations representing sections a little rootwise from the floor of the pulp chamber (*c*). This is best seen in the specimen itself; and the position and the direction of the canals, with relation to the walls of the pulp chamber and the main points of the surface of the crown, should be carefully studied.

174. The opening into the **lingual root** (Fig. 117, *b*) is the simplest and most direct. Generally, it begins in a funnel-shaped opening inclining to the lingual, which quickly narrows to the dimensions of a moderately small canal, and continues to taper to the apical foramen. It is usually straight, or but slightly curved.

175. The opening into the **mesial canal** is under the mesio-buccal cusp, close against the mesio-buccal angle of the pulp chamber. It often happens that this canal begins in a groove in the angle of the chamber (Fig. 119, *b*), making this the thinnest point in the dentinal walls surrounding it. In young teeth, the mouth of the canal is of a flattened funnel-shape, which is quickly contracted into a very fine canal; but in the adult, it often begins as a fine canal. Its course at first is to the buccal and mesial, and then curves to the distal. It is usually distinctly flattened, and often has a thin edge to the lingual. It is often a very difficult canal to clean with a broach. To **find this canal** the point of the broach should be directed into the mesio-buccal angle of the pulp chamber; and, while held against the wall within this angle, it is slid toward the root. It will rarely fail to glide into the canal.

176. The **distal canal** usually begins abruptly as a fine opening (Fig. 117, *a, c*), situated at the disto-buccal angle of the floor of the pulp chamber (Figs. 118 and 119); so that a

broach pressed into that angle will easily glide into it. But in some instances, especially in the upper second molars, the opening is in the floor of the pulp chamber at a little distance from the immediate angle toward the center of the floor, and then, in positions which limit the use of the eye, it is often difficult to find. In teeth much flattened at the neck, the opening of this canal may begin very close to the mouth of the mesial canal (Fig. 120, *a*), or close against the distal wall of the chamber, half-way from the buccal to the lingual wall, or anywhere between this point and the disto-buccal angle. The first direction of the canal will vary according to its position. If it is found in a fairly well-defined disto-buccal angle of the chamber, its direction will be a little inclined to the distal, and the broach will penetrate it easily; if in the floor of the chamber, it will sometimes be straight, as in the former case; but more generally the first direction will be to the distal and buccal, with considerable curve afterward. If found close to the mesial canal, its course is usually first sharply to the distal, when it curves rather abruptly toward the apex of root. If found along a smooth or curved distal wall, the course will generally be to the distal and buccal, with but little curve. This canal is usually very fine from its beginning, and almost or quite round.

177. While the **canals** are similar in all of the upper molars, there are differences in the form of the floor of the pulp chamber that may be briefly generalized. The pulp chamber of the upper second molar (Fig. 120) is usually much more flattened from mesial to distal than in the first molar. This changes the relation of the mouths of the canals somewhat, rendering the distal angle of the triangle formed by them more obtuse, and brings the mouth of the distal canal nearer the mesial line of the triangle, so that it seems to be found along the distal wall of the narrowed chamber. In others, it is found in the extreme buccal portion crowded close against the mouth of the mesial canal.

178. The **position** of the openings of the canals in the

Fig. 117.

Fig. 118.

Fig. 119.

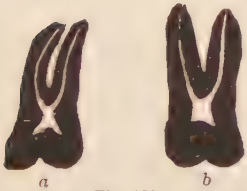

Fig. 120.

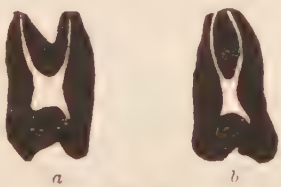

Fig. 121.

FIG. 117* (Par. 172).—PULP CHAMBER AND ROOT CANALS OF THE UPPER FIRST MOLAR. *a, c,* Mesio-distal sections, showing the pulp chamber and the canals in the mesial and distal roots; *b,* bucco-lingual section, showing the pulp chamber and the canals in the mesial and lingual roots; *d,* bucco-lingual section, showing the chamber and the canals in the distal and lingual roots.

FIGS. 118,* 119* (Par. 173).—PULP CHAMBER AND ROOT CANALS OF THE UPPER FIRST MOLARS, cross sections. *a,* Centrally through the pulp chamber; *b,* section just at the floor of the pulp chamber; *c,* section a little rootwise from the pulp chamber, showing the canals and the form of the molar triangle.

FIG. 120* (Par. 177).—PULP CHAMBER AND ROOT CANALS OF THE UPPER SECOND MOLAR. *a,* Mesio-distal section, showing pulp chamber and the canals in the mesial and distal roots; *b,* bucco-lingual section, showing the chamber and the canals in the distal and lingual roots.

FIG. 121* (Par. 178).—PULP CHAMBER AND ROOT CANALS IN THE UPPER THIRD MOLAR. *a,* Bucco-lingual section, showing pulp chamber and the canals in the mesial and lingual roots; *b,* mesio-distal section of a single rooted tooth, showing the form of the pulp chamber and the mesial and distal root canals.

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* Illustration, actual size.

upper third molar (Fig. 121) is usually much the same as in the first and second, varying so as to resemble either. Occasionally there is more than the usual number, and others with only one or two. When there is but one, it is commonly quite large. Four, five, or even seven or eight, are sometimes found.

PULP CHAMBERS OF THE LOWER MOLARS.

179. *Dissections*—1st. Saw the tooth through the gingival line dividing the crown from the root. This cut will pass through the body of the pulp chamber and give a good view of the roof and floor, and a good idea of the general form. The root canals should be cleaned and examined with the broach.

2d. Saw the tooth through from end to end centrally from mesial to distal, or grind or file away the buccal side till the pulp chamber and the root canals are exposed. As there are usually two canals in the mesial root, an exact central cut from mesial to distal will generally fail to expose the canals, and the cut will be better made at a slight angle, so as to expose either the buccal or lingual canal of the mesial root.

3d. Grind or file away the **mesial surface** of the crown and root till the pulp chamber and the whole length of the canals in the mesial root are exposed. As this root is usually curved, the cutting must be done with care, and the curve followed.

4th. **Cross-sections** of the roots should be made at intervals. An excellent study is to begin grinding at the apex of the roots, printing occasionally, and continuing the grinding until the pulp chamber is reached. This will display cross-sections, at intervals, of the entire root canals. Enough of these dissections should be made of each of the lower molars to make the student familiar with each class.

180. The **pulp chambers** of the **lower molars** (Figs. 122, 123, 124) have the same general form as the surface of the crown, but are generally rather more angular. The wall of the

chamber toward the occlusal surface is convex toward the pulp; the horns extend from the extreme angles toward the apex of each cusp. The floor through the central portion is arched or convexed mesio-distally, and concave bucco-lingually. The mesial wall of the cavity is flat, and longer than the distal. The mesio-buccal and mesio-lingual angles are sharp and projecting, while the distal angles are rounded (Fig. 123, *d, g*). The size of the chamber varies much. In youth its diameter is often as much as two-fifths of the crown and seldom less than one-third. This diminishes as age advances, and in old age it is often very small, or, especially where there has been considerable abrasion of the teeth, the pulp chamber may be almost obliterated.

181. The **root canals** of the lower molars proceed from the mesial and distal portions of the pulp chamber (Fig. 122, *a, b*). The **mesial canal,** at its mouth, is usually about as broad from buccal to lingual as the whole breadth of the chamber, including its angular projections. Either at, or a little rootwise from the floor of the pulp chamber, it is usually divided into two very small canals which diverge at first, and approach each other afterward, but usually remain distinct, each ending in its own apical foramen (Fig. 122, *c*). Occasionally, however, they are united in the apical third of the root, and end in a common apical foramen. Again, there may be a communication between them in the apical portion of the root, each canal remaining otherwise complete in itself. A few have one broad flattened canal (Fig. 123, *d, e, f*). These canals are usually minute, and very difficult to thoroughly clean with the broach, though the mesio-buccal canal is usually easily found, if the pulp chamber is thoroughly opened. By placing the point of the broach in the **mesio-buccal angle** of the chamber and pushing it gently on, it will generally glide into the canal. The first direction inclines to the mesial and buccal, after which it curves to the distal and lingual (Fig 122, *c*). Generally, these curves are easy, without short bends. The broach easily glides into the mesio-lingual canal by placing

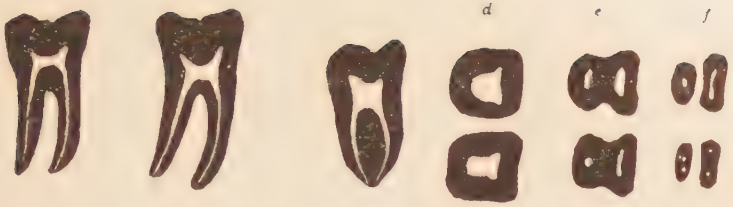

Fig. 123.

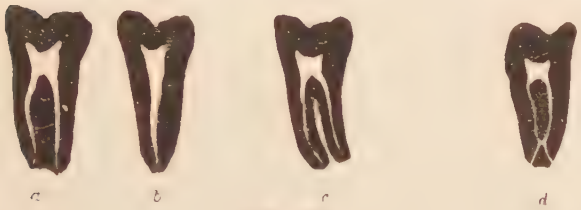

Fig. 124

Fig. 125.

FIG. 122* (Par. 180).—PULP CHAMBER AND ROOT CANALS OF THE LOWER FIRST MOLAR. *a, b,* Mesio-distal sections, showing the form of the pulp chamber and root canals; *c,* bucco-lingual section, showing the canals in the mesial root.

FIG. 123* (Par. 180).—CROSS-SECTIONS THROUGH THE CROWN AND ROOT OF THE LOWER FIRST MOLAR, showing the pulp chamber and root canals. *d, g,* Sections through the pulp chamber; *e, h,* sections a little rootwise from the pulp chamber; *f, i,* sections near apex of root.

FIG. 124* (Par. 180).—PULP CHAMBER AND ROOT CANALS OF THE LOWER SECOND MOLAR. *a, c,* Mesio-distal sections, showing the form of the pulp chamber and foot canals; *b,* bucco-lingual section of the distal root and crown; *d,* bucco-lingual section through the mesial root and crown, showing two canals with communication in the apical third of the root. This communication is not very common.

FIG. 125* (Par. 182).—PULP CHAMBER AND ROOT CANALS OF THE LOWER THIRD MOLAR. *a, c,* In double-rooted teeth; *b,* single-rooted teeth.

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* Illustration, actual size.

the point in the **mesio-lingual angle** of the pulp chamber and sliding it toward the root. The first inclination is to the mesial, but occasionally to the lingual, after which it curves to the distal and buccal.

182. The **distal canal** is approached by a funnel-shaped opening, of which the central part of the distal wall of the pulp chamber becomes a portion. Its direction is a little to the distal, and is generally very nearly straight to the apex. At first, it is flattened, with the long diameter from buccal to lingual, and progressively becomes rounded, and tapers regularly to the apical foramen. It is generally much larger than the canals of the mesial root, and is easily cleaned with the broach. If the mouth is wide open, and the handle of the broach brought against the **upper central incisors** with the point directed against the posterior wall of the pulp chamber, it will easily glide into the canal, and pass to the apical foramen. This particular position for easily entering the distal canal is important for all the lower molars. Occasionally, the lower third molar has but one root canal (Fig. 125, *b*), which is then generally very large. More rarely, only a single canal will be found in the lower second molar, but generally the canals of the second and third lower molars are similar to those of the first. The pulp chambers are usually smaller, and oftener irregular in outline. The lower third molar has, occasionally, a very large pulp chamber.

VARIATIONS OF THE FORM OF PULP CHAMBERS.

183. Many variations of form occur in the pulp chambers and root canals. The roots of the teeth may be abnormally crooked; and then the canals will be abnormally crooked. In many instances, the pulp chamber will have in it **secondary formations,** called **nodules,** which may be adherent to the walls, or block the mouths of the canals and prevent a broach gliding into them. These also occur, occasionally, within the canals, partially blocking the way of the broach. Sometimes the pulp chamber will be filled with

nodular deposits so completely that there seems to be no room for the tissues of the pulp. These deposits will have to be removed before the root canals can be reached and entered, after which the canals will generally be found open. These deposits occur within the pulp chambers of any of the teeth; but they cause annoyance more frequently in the molars.

184. Occasionally **lateral openings** occur from the root canals to the surface of the root. I have seen more of these from the canals of the lower molars than from those of any other teeth. Generally, they follow the course of the dental tubules, and open on the side of the root. They may diverge to one side and curve toward the apex of the root. These cannot often be detected, except in dissections of the root, and occur so rarely they may be ignored in practice.

185. Sometimes the **horns of the pulp** approach abnormally near the points of the cusps of some of the teeth, as in the upper first bicuspids and in the mesio-buccal cusp of the upper first molar. Then the pulp is more liable to exposure in excavating carious cavities.

PULP CHAMBERS OF THE DECIDUOUS TEETH.

186. The pulp chambers of the **deciduous teeth** are proportionately larger, and the thickness of their walls less, than those of the corresponding permanent teeth. The pulps are, in consequence, exposed with much less penetration of tooth substance, and, therefore, more liable to exposure from caries, or in the use of cutting instruments. The root canals are generally larger than in the permanent teeth of the same denomination, but are of the same general form. Also, the same rules for finding the root canals in the permanent molars apply to the deciduous.

ARRANGEMENT OF THE TEETH.

187. The **upper teeth** are arranged in the form of a **semi-ellipse**, the long axis passing between the central incisors (Figs. 126 and 127). In this curve the cuspids stand a

little prominent, giving a fullness to the corners of the mouth. In different persons there is much variation of the form of the arch within the limits of the normal. Occasionally the bicuspids and molars form a straight line, instead of a curve, and frequently the third molars are a little outside the line of the ellipse. In the examination of casts of the most perfect dentures it is found that the two sides do not perfectly correspond, and that certain teeth deviate slightly from the perfect line. The incisors are arranged with their cutting edges forming a continuous curved line from cuspid to cuspid, and this line is continued over the cusps of the cuspids and the buccal cusps of the bicuspids and molars to the distal surface of the third molars. From the first bicuspid to the third molar the lingual cusps of these teeth form a second line of elevations. Between these two, the lingual and buccal cusps, there is a continuous, but irregular, valley or sulcus.

188. The **lower teeth** are arranged similarly (Fig. 185), but on a slightly smaller curve, so that the line of the ellipse, which falls on the buccal cusps of the upper bicuspids and molars, will fall upon the buccal surfaces near the gum on the lower teeth (Fig. 126). Therefore, in occlusion, the upper teeth project a little to the labial and buccal of the lower at all points of the arch (Fig. 131). The incisors and cuspids occlude so that the cutting edges of the lower incisors and cusps of the cuspids make contact with the lingual surfaces of the similar teeth of the upper jaw near their cutting edges (Fig. 128). In this, however, there is much variety within the limits of a **normal occlusion.** Sometimes the lower incisors strike the lingual surfaces of the upper near the linguo-gingival ridge, and may strike at any point between that and the cutting edges. In **abnormal occlusions** the lower incisors may miss the upper, striking the gums posterior to them, or they may occlude anterior to the upper incisors. The broad-cusped occlusal surfaces of the bicuspids and molars of the opposing dentures rest on each other in such a way that the lingual cusps of the upper teeth fit with more or less

accuracy into the general sulcus formed between the buccal and lingual cusps of the lower teeth. The buccal row of cusps of the lower teeth, in a similar way, are fitted into the sulcus formed between the buccal and lingual cusps of the upper teeth (Figs. 129 and 130). This arrangement is such that when the teeth are in occlusion, it leaves the buccal inclines of the buccal cusps of the upper teeth outside the buccal surface of the lower teeth (*a*), and, also, leaves a ledge formed by the abrupt lingual inclines of the lingual cusps of the lower teeth along the lingual line of the occlusion (*b*). This brings the occlusal surfaces of the teeth in the best form of apposition for the purposes of mastication. The forms presented to the cheek and to the tongue hold these soft tissues a little apart from the actual contact-points of the occlusion, and thus prevent them from being caught and pinched, or crushed, between the teeth in the act of mastication. In youth, while the permanent teeth are taking their places, and before the cusps are properly fitted to the sulci, we often find the cheeks or tongue wounded by being caught between falsely occluded points. With the after movements of the teeth, by which they are more perfectly arranged, this difficulty disappears.

189. The line from before backward on which the occlusion occurs is not quite a plane; in the lower jaw it presents a slight curve, or concavity, and in the upper jaw a convexity (Fig. 131, *c* to *d*). This concavity of the line of the occlusal surfaces of the lower teeth is a little greater than the convexity of the upper, so that the cutting edges of the lower incisors pass a little beyond, and to the lingual of the cutting edges of the upper incisors.

190. In the occlusion the relative mesio-distal position of the particular teeth of the upper jaw to the lower is important (Fig. 131). At their cutting edges, the upper central incisors are about one-third wider mesio-distally than the lower centrals. The upper central, therefore, occludes with the lower central, and also with from one-third to one-half of the lower lateral incisor. The upper lateral occludes with

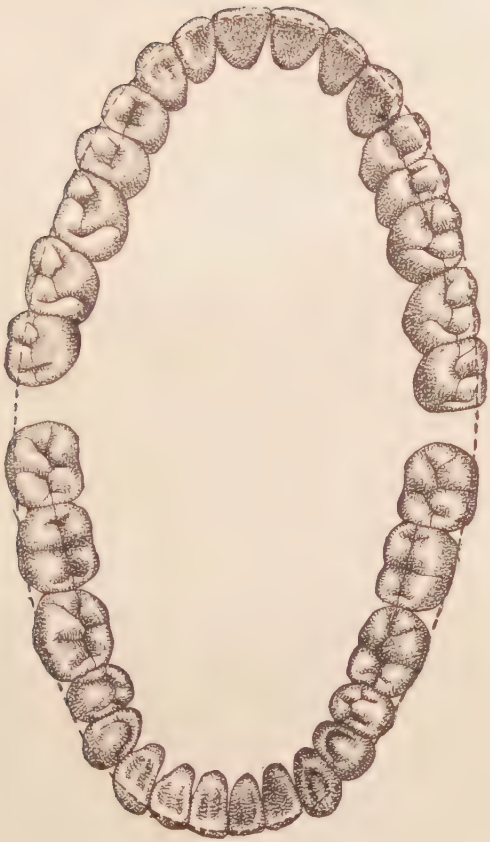

Fig. 126.

Fig. 126 (Par. 187).—The Elliptical Form of the Arch. The crowns of the teeth of both upper and lower jaws, drawn from the casts of a very regularly formed arch, and the line of a true ellipse (in dots) placed over them, showing the comparative size of the upper and lower arch, and the deviations from perfect regularity.

the remaining portion of the lower lateral and the mesial portion of the lower cuspid. The upper cuspid is usually rather broader mesio-distally than the lower, and in occlusion covers its distal two-thirds and about half of the lower first bicuspid, so that its lingual, or triangular ridge, is between the cusp of the lower cuspid and the buccal cusp of the lower first bicuspid, the point of its cusp overlapping the lower teeth. The buccal cusp of the lower first bicuspid occludes in the space between the upper cuspid and upper first bicuspid. This order is now maintained between the bicuspids. The buccal cusp of the upper first bicuspid overlaps (to the buccal) the space between the two lower bicuspids, and its lingual cusp occludes in the sulcus between them, while the buccal cusp of the lower second bicuspid occludes in the sulcus between the two upper bicuspids. The cusps of the upper second bicuspid occlude between the lower second bicuspid and lower first molar. The broad surfaces of the molars come together, so that the mesial two-thirds of the upper first molar covers the distal two-thirds of the lower first molar, and the distal third of the upper first molar covers the mesial third of the lower second molar. This brings the oblique ridge of the upper molar between these two lower teeth. This order is continued between the remaining molars, but less perfectly as the teeth are more irregularly formed. The upper third molar is usually smaller than the lower third molar, yet it generally extends over its distal surface.

191. The **inclination of the teeth** is the deviation of their long axes from the perpendicular line. The direction of the inclination is expressed by some accompanying word. The upper incisors and cuspids are so arranged that their crowns are inclined more or less forward, or toward the lip, and slightly toward the median line. The mesial inclination is continued in the bicuspids and molars, diminishing from before backward, and is usually lost at the second or third molar. As a rule, the bicuspids and molars of the upper jaw are also slightly inclined toward the cheek, but in many den-

tures this inclination is slight, or wanting in the bicuspids and first molars to reappear in the second and third molars, though it may be absent even in these without necessary malformation.

192. The **lower incisors** and **cuspids** are also inclined with their crowns toward the lip, but in less degree than the upper. And even the perpendicular position of these is not inconsistent with a normal arrangement. They have, however, a mesial inclination, but usually much less than the corresponding upper teeth. The **lower bicuspids,** within the limits of the normal arrangement, vary considerably in their inclinations. Sometimes they have a strong mesial inclination, and at other times they are nearly or quite perpendicular. In many dentures, they also have a lingual inclination, but may be perpendicular or even have a slight buccal inclination. The **lower molars** usually have a slight mesial and lingual inclination (Fig. 135). In many examples, however, the mesial inclination is wanting, especially in the second and third molars.

193. All the teeth are a little broader mesio-distally at or near the occlusal surfaces than at their necks. Therefore, when arranged in the arch with their proximate surfaces in contact, there is a considerable space between their necks (Fig. 131). These are known as the **inter-proximate** or **V-shaped spaces.** The sharp angle or apex of the V-form is toward the occlusal surface, or at the contact-point of the proximation, and the open end or base is at the crest of the alveolar process (Figs. 134, 135, 136). In normal conditions, this space is filled by the soft tissues, or **gums** (141). The average arch measures about 127 millimeters (5 inches) from the distal surface of the right third molar to the distal surface of the left third molar, following the curve of the arch, on the line of the contact-points of the teeth. This represents the average mesio-distal measurement of the crowns of the teeth of the upper jaw taken collectively. The average measurement of the teeth at their necks is about 89 millimeters (3.5

Fig. 127.

Fig. 128.

Fig. 129.

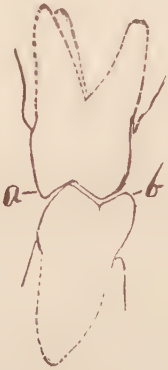

Fig. 130.

Fig. 127* (Par. 187).—Arrangement of the Teeth in the Arch. The arch of the upper jaw.

(Par. 210).—The Teeth and the Gums and the Rugæ of the Roof of the Mouth.

Fig. 128 (Par. 188).—Labio-Lingual Position of the Incisors in Occlusion.

Fig. 129 (Par. 188).—Bucco-Lingual Position of the Bicuspids in Occlusion.

Fig. 130 (Par. 188).—Bucco-Lingual Position of the Molars in Occlusion.

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* Illustration, actual size.

inches). The remaining 38 millimeters (1.5 inches) represent the average sum of the inter-proximate spaces taken collectively.

194. On account of differences in the **conformation of the crowns** and the **inclination of the teeth** the inter-proximate spaces vary much in width in different dentures. They are much wider between bell-crowned teeth than between thick-necked teeth; but some inter-proximate space exists in every normal denture. When the crowns of the incisors and cuspids are much inclined toward the lip, the necks of the teeth form a smaller circle than the line of the contact-points of the proximation, and in this way the inter-proximate spaces may be considerably narrowed. Generally, the inter-proximate space is wide between the necks of the central incisors. The suture joining the maxillary bones passes between the roots of these teeth, and they are somewhat farther apart than the roots of the central and lateral incisors, or those of the lateral incisor and the cuspid. Therefore, in these latter, the inter-proximate spaces are of less width (Fig. 134). Between the bicuspids the inter-proximate spaces are wider at the necks of the teeth than between the anterior teeth, on account of the greater breadth of the crowns as compared with the roots (Fig. 135, *b*). The widest inter-proximate spaces are usually between the necks of the molars (Figs. 135 and 136, *c*).

When the proximate surfaces of the teeth are carefully examined it is found that at the level of the contact-point they are more or less rounded from buccal to lingual, and in this rounding the mesio-distal diameter of the bicuspids and molars is narrowed more toward the lingual than toward the buccal. This gives rise to spaces between the angles of the teeth, which begin at the point of proximate contact and widen toward the buccal on the one side and toward the lingual upon the other. These are the buccal and lingual **inter-proximate embrasures** (see Figs. 132 and 133). The depth of these embrasures and their width vary greatly in different dentures. Usually between bell-crowned teeth they are deep,

while between thick-necked teeth they are shallower. The lingual embrasures are generally much deeper than the buccal between the angles of the bicuspids and molars, while the labial embrasures are deeper than the lingual between the angles of the incisors.

The form of these inter-proximate embrasures seems to be important with reference to cleanliness of the inter-proximate spaces; for when they are deep, food, in its excursions over the teeth and gums during mastication, is directed into them, and is caused to glide out to the lingual and to the buccal, rubbing through the embrasures and over the gum septum and carrying away all débris that may have found lodgment about the inter-proximate spaces.

195. The **points of proximate contact** in the best-formed arches are near the occlusal surfaces of the teeth. In imperfectly developed teeth, in which the crowns are much rounded toward the occlusal surfaces, the contact-points are more toward the gingival. In the incisors and cuspids they are in direct line with the cutting edges (Fig. 132, *a*). In the bicuspids the contact is near the mesio- and disto-bucco-occlusal angles and nearly in line with buccal cusps (Fig. 132, *b*). The mesial and distal flattened surfaces of these teeth converge to the lingual to such an extent that, though they are arranged in arch form the contact-points remain close to the buccal-point angles. In many excellent dentures there is a decided interproximate embrasure opening to the **lingual,** but in thick-necked teeth and those of a more rounded contour, the contact-points are often more toward the lingual, and there is but a slight lingual embrasure. In the molars the contact-points, as a rule, are removed rather more to the lingual, but still in the best-formed dentures they will be found nearly in line with the buccal cusps (Fig. 132, *c*). Between the upper first and second molars the contact-point is often extended toward the lingual by the prominent disto-lingual cusp of the first molar; and, even when otherwise, the general rounding of the distal surfaces of the upper molars often

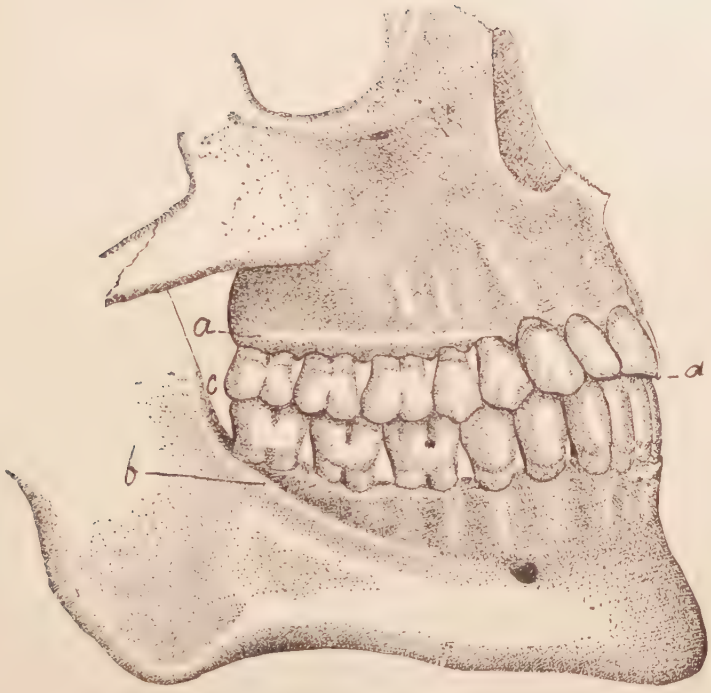

Fig. 131.—Actual size.

Fig. 131 (Par. 188).—Arrangement of the Teeth. Labial and buccal aspect of the upper and lower teeth as arranged in the arch.

(Par. 197).—The Alveolar Process of the Upper and Lower Jaws, with the Teeth in Position.

brings the contact-point near the middle line of the teeth. In lower first molars the large distal cusp brings the contact-point with the second molar close to the buccal side, with a considerable lingual inter-proximate embrasure (Fig. 133, *c*). If the distal cusp is small, the contact-point is usually extended toward the lingual, often as far as half the bucco-lingual breadth of the teeth. Between the second and third molars the contact-point is most frequently near the central line of the teeth (Fig. 133, *d*). In the best-formed dentures the **form** of the **proximate contact** is such as to prevent food from being crowded between the teeth in mastication, and therefore, such as to keep these spaces clean and the inter-proximate gingivæ in health. But many **faulty forms** are met with which allow food to leak through into the inter-proximate space and crowd the gum away, forming a pocket for the lodgment of débris, giving opportunity for decomposition, and resulting in caries of the proximate surfaces, or disease of the gum and peridental membrane. A close study of the forms of proximate contact in the best-formed dentures demonstrates that the immediate contact-point is on rounded prominences of the proximate surfaces. The rounding of the surfaces bucco-lingually and the form of the buccal and lingual inter-proximate embrasures are well shown in Figs. 132 and 133, which were made by removing the occlusal surfaces of the teeth by grinding until the contact-points were reached, and then accurately drawing the outlines to show the form of the contact-points. In Figs. 134, 135, and 136 the outlines of the teeth are carefully drawn, so as to illustrate the form of the contact occluso-gingivally, from which it will be seen that they are sharply rounded in this direction also. Therefore the proximate contact of the teeth is such as would be made by the contact of two marbles, or at a single small point. These points of proximate contact also slide slightly upon each other in the act of chewing food, the peridental membranes allowing the teeth a slight motion, so that any substance forced between them easily glides out in one way or

the other. Furthermore, the form of the inter-proximate gum tissue, the gum septum, is that of an arch with its convex side toward the point of contact or occlusal surfaces of the teeth. Therefore, food-material forced past the rounded point of contact, and lying loosely in the inter-proximate space, and upon this rounded and tolerably firm gum septum, is caught and carried away by the gliding motion of food over the axial surfaces of the teeth and over the gum tissue in the act of chewing. This is facilitated greatly by wide buccal and lingual inter-proximate embrasures, which allow the food to glide through them during mastication. In this way the proximate surfaces of normally well-formed teeth are kept free from lodgments as long as the gum septum retains its normal form and firmness. In many individuals of middle, or advanced age, the points of proximate contact become much worn and flattened by rubbing on each other during mastication. From this cause they often become so broad as to hold food-material firmly between them, which is gradually forced against the gum septum, causing its absorption, and forming a pocket for the lodgment of débris, and thus gives rise to serious difficulties. Facets formed by inter-proximate wear may be found in any collection of teeth. Exceptionally cases are met with in which the teeth stand so widely apart that they are self-cleaning. The form of the inter-proximate space is very variable. The forms best suited to the maintenance of the health of the teeth and gums are so important to the student of operative dentistry that they should be very closely studied. It is best studied in skulls in which the teeth are all present, by careful selection and arrangement of teeth with their roots in wax, gutta-percha, or plaster, to hold them in normal relation to each other, and by careful consideration of the forms of the proximate surfaces of the teeth together with their relative positions.

THE ALVEOLAR PROCESS AND ALVEOLI.

196. The **alveolar process** is the projecting portion of the maxillary bones within which the roots of the teeth

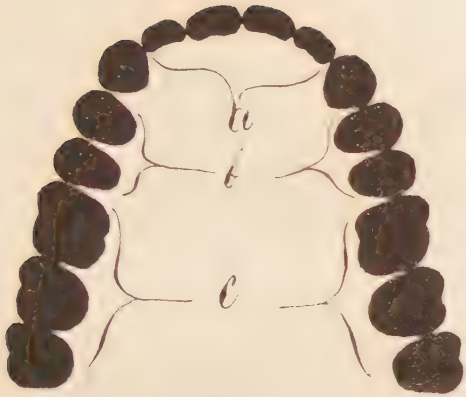

Fig. 132.

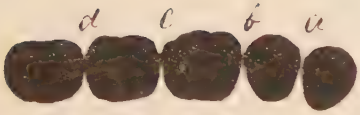

Fig. 133.

Fig. 134.

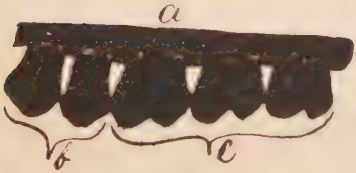

Fig. 135.

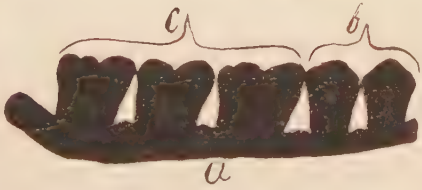

Fig. 136.

Fig. 132 (Pars. 194, 195).—The Form of the Inter-Proximate Contact from Buccal to Lingual of the Upper Teeth. The occlusal surfaces of the teeth are ground away until the contact-points are reached, and then the outlines are accurately drawn in silhouette. *a*, Incisors; *b*, bicuspids; *c*, molars.

Fig. 133 (Pars. 194, 195).—The Form, Bucco-Lingually, of the Inter-Proximate Contact of the Lower Molars and Bicuspids. The occlusal surfaces of the teeth are ground away until the contact-points were reached and the outlines accurately drawn in silhouette. *a*, Contact of the bicuspids; *b*, contact of the second bicuspid and first molar; *c*, contact of the first and second molars; *d*, contact of the second and third molars.

Fig. 134 (Pars. 194, 195).—The Form, Occluso-Gingivally, of the Inter-Proximate Contact and of the Inter-Proximate Space between the Upper Incisors. *a*, Alveolar process.

Fig. 135 (Pars. 194, 195).—The Form, Occluso-Gingivally, of the Inter-Proximate Contact and of the Inter-Proximate Spaces between the Bicuspids and Molars of the Upper Jaw. *a*, Alveolar process; *b*, bicuspids; *c*, molars.

Fig. 136 (Pars. 194, 195).—The Form, Occlusal-Gingivally, of the Inter-Proximate Contact and of the Inter-Proximate Spaces between the Lower Bicuspids and Molars. *a*, Alveolar process; *b*, bicuspids; *c*, molars.

are lodged in alveoli, or sockets, accurately fitted to their surfaces (Figs. 137 and 138). The form of the alveolar process seems to depend on the teeth, the conformation of their roots, and their arrangement in the arch. If any teeth are misplaced, or from any cause stand out of the regular and normal line, the alveolar process is formed about their roots in this irregular position. Also, when teeth are lost, the alveolar process mostly disappears by absorption, and the remaining portions of the alveoli are filled with bone.

197. **Normally,** the alveolar process envelops the roots of the teeth to within a short distance of the gingival line (Figs. 131 and 139), varying from one to three millimeters in the young adult. This distance increases somewhat with increasing age. The borders of the alveolar process are reduced to a thin edge about the necks of the teeth on both the labial and lingual sides of the incisors and cuspids of the upper jaw. About the lingual sides of the necks of the bicuspids and molars the borders are also reduced to a thin edge, becoming slightly thickened about the second and third molars, especially the latter. On the buccal sides of these, a thickening of the immediate borders of the alveolar process, in the form of a marked ridge, begins about the first or second bicuspid, more commonly between these two, and extends to the distal of the third molar (Fig. 131, *a*). This ridge varies in different examples, from a very slight thickening of the immediate border to a thickness of two or three millimeters. It forms a border standing squarely out from the necks of the teeth. The alveolar process then thins away so that, in many instances, the buccal roots of the teeth, especially the mesial root of the first molar, have but a thin covering of bone.

198. **Anteriorly,** the bony covering of the roots of the upper incisors presents much variety. In some examples, the middle portion of the roots has but a slight covering of bone, but more generally it is progressively thickened from the neck to the apex. The roots of the cuspids are prominent toward the lip, and, for most of their length, have only a thin bony

covering, and this forms a ridge along the line of the root, which may easily be traced with the finger through the soft tissues of both the gum and lip. In many instances, the bony covering is entirely wanting for a little space near the middle of the length of the root of the cuspid, the buccal root of the first bicuspid, the mesial root of the first molar, and, occasionally, of other teeth.

199. On the **lingual side** of the upper teeth (Fig. 139) the progressive thickening of the alveolar process, from the border toward the apex of the root, is much greater, so that the roots of the teeth seem to lie toward the labial and buccal side of the alveolar process (Fig. 137). Even the large lingual root of the upper first molar, diverging strongly to the lingual, seldom forms a ridge or prominence of the process covering its lingual surface.

200. The **anterior palatine foramen** is in the median line just behind the central incisors (Fig. 139). It is funnel-shaped, with a broad opening to the palatine surface of the bone. The bone is often quite thin between this and the roots of the central incisors. The **posterior palatine artery** runs in a deep groove in the surface of the bone, very close to the apex of the lingual roots of the upper third and the upper second molar. This artery is occasionally wounded, or cut, in efforts to extract the roots of these teeth.

201. In the **lower jaw** the immediate borders of the alveolar process, on the labial sides of the incisors, are rather thicker than in the upper jaw, often amounting to a decided ridge. This, however, thins away rapidly, so that the middle portion of the root has but a thin covering of bone. At the cuspid the border of the alveolar process is very thin, but a gingival ridge, corresponding with that of the upper jaw, though not so prominent, begins at about the first or second bicuspid and runs to the second molar. This thins away over the middle of the length of the roots of the bicuspids and first molar. At the second lower molar, the rising of the **external oblique ridge** for the formation of the anterior border of the

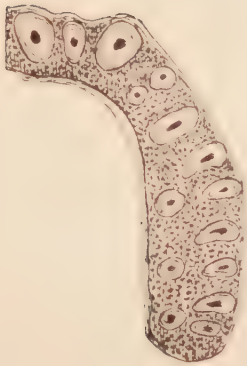

Fig. 137.

Fig. 138.

Fig. 139.

Fig. 137* (Par. 196).—Horizontal Section of the Alveolar Process and Roots of the Teeth of the Upper Jaw, showing the roots of the teeth in position.

Fig. 138* (Par. 196).—Horizontal Section of the Alveolar Process and Roots of the Teeth of the Lower Jaw, showing the roots of the teeth in position.

Fig. 139* (Par. 197).—The Teeth and Lingual Portion of the Alveolar Process of the Upper Jaw, and the Bones of the Roof of the Mouth.

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* Illustration, actual size.

coronoid process (Fig. 131, *b*) causes a thickening of the buccal bony covering of the root, while at the third molar this ridge rises to a level with the border of the alveolar process, making the bony covering on the buccal side of the root about one-fourth of an inch thick (Fig. 138). This is of importance with reference to the extraction of the roots of this tooth. Indeed, the second and third molars of the lower jaw are fixed in alveoli, hollowed out in the lingual side of the body of the bone rather than in a process or ridge on the bone, as with the teeth anterior.

202. On the **lingual side** of the lower anterior teeth the border of the alveolar process is a smooth, thin edge, and the covering of bone over the roots progressively thickens toward their apexes. In this portion the process is high, and the labio-lingual thickness is only sufficient to envelop the roots of the teeth and give them support (Figs. 140 and 142). From the first bicuspid backward the height of the alveolar process diminishes rapidly, and the line of the dental arch and of the alveoli of the teeth passes diagonally across the line of the curve of the body of the bone, from the buccal side at the first bicuspid to the lingual side at the third molar, and sinks into the body of the bone (Figs. 140 and 142). The border of the alveolar process remains thin as far as the first or second molar, but the bony covering of the roots is rapidly thickened toward their apexes.

203. This is caused largely by the thickening of the body of the bone, produced by the rise of the **mylohyoid ridge** (Fig. 142, *a*), which begins in front below the apexes of the roots and rises progressively backward nearly to the border of the alveolar process at the third molar. The greatest thickness is over the lingual side of the apical half of the roots of the second molar, and of the crossing of the lingual side of the coronal half of the roots of the third molar. At the third molar this ridge is thinner, and at the distal angle often very slight, while the lingual covering of the roots of the tooth may be very thin below this ridge. Therefore, it is usually easy, when

necessary in extracting, to force the roots of the lower third molar to the lingual and distal with a level suitably arranged against the crown of the second molar, as with the Physic's forceps, or an elevator.

204. The borders of the **septa** of the alveoli of the roots of the anterior teeth are rounded, or arched labio-lingually, but this diminishes rapidly from the cuspid backward. Between the molars it is a straight line, or presents but a slight concavity, so that the highest points of the border of the alveolar process are on the buccal and lingual surfaces, or at the angles, of the necks of these teeth, which is important in fitting bands of crowns or any similar processes.

205. The **alveolar process** is composed of an outer and an inner plate of moderately compact bone, and between these, very open cancellous or spongy bone; so that in young persons it may be forced more or less to one side, or bent out of position, without definite fracture. The outer compact plate forms the outer surface of the bone, the inner plates line the alveoli of the teeth. These latter are very thin, and supported on all sides by the cancellous structure. In the lower jaw the substance of the bone is more compact and stronger than in the upper, especially about the molar teeth, where the alveoli are in the substance of the body of the bone.

THE PERIDENTAL MEMBRANE.

206. The **peridental membrane** invests the roots of the teeth from the gingival line to the apexes of the roots like a sack. It lines every part of the alveoli, and, passing over the gingival margins, is continuous with the periosteum and gums covering the outer plate of the alveolar process. It is one membrane, attached on one side to the root of the tooth, and on the other to the inner wall of the alveolus. It is composed of connective tissue which supports an abundant supply of blood-vessels, nerves and lymphatics. With these are intermingled strong fibers of white fibrous tissue which pass from the cementum of the root of the tooth to the bony walls of the

Fig. 140.—Actual size.

Fig. 141.—Actual size.

Fig. 140 (Par. 202).—Lower Teeth and Maxilla, as seen from above.

Fig. 141 (Par. 210).—The Labial and Buccal Aspect of the Teeth and Gums of the Upper Jaw.

alveolus. The ends of these are built firmly into each, forming a strong attachment of the root to its alveolus. In childhood and youth, this membrane is comparatively thick, and allows considerable motion of the tooth in its socket. As age advances, it becomes thinner and the motions of the teeth are more restricted. A bundle of nerves and one or more arteries enter the alveolus near the apex of the root (the apical space), and, subdividing, several arterial twigs and nerve bundles pass toward the gingivæ, while others enter the apical foramen and pass to the pulp of the tooth. Also, the cancellous portion of the bone forming the alveolar process is richly supplied with blood-vessels and nerves, and these enter the alveolus peridental membrane from all sides. This gives the peridental membrane a very rich collateral circulation. At the gingivæ, the blood-vessels become continuous with those of the periosteum and gums.*

THE GUMS.

207. The gums are the soft tissues covering the alveolar processes and investing the necks of the teeth. They are composed of **connective tissue** containing many white fibers intermingled, forming a firm membranous mass, continuous with the periosteum beneath, and with the peridental membrane at the necks of the teeth. They are covered with a strong outer coat of **squamous epithelium.** They are richly supplied with blood-vessels and nerves; under normal conditions they are not very sensitive to pressure or moderate violence, but in pathological conditions they may become very sensitive.

208. On the **labial** and **buccal side** of the alveolar process the gums (Fig. 136) are thin and firm near the necks of the teeth and strongly attached to the periosteum. As they pass from the necks of the teeth toward the base of the alveolar ridge they become softer, lose their close attachment to the

*For the details of this subject the student is referred to the author's treatise on "The Histological Characters of the Periosteum and Peridental Membrane."

periosteum, and become merged into the mucous membrane of the lips and cheeks. In the passage from the gums to these mucous surfaces several loose folds are formed, the most notable being the **frenum labium** of the upper jaw at the median line, passing from near the inter-proximate space of the central incisors to the median line of the upper lip. A similar, though less prominent fold connects the median line of the lower lip with the gums. Occasionally, folds of less prominence are seen in the neighborhood of the bicuspids and first molars.

209. On the **lingual side** of the arch, in the lower jaw, the conditions are much the same. The gums are firmly adherent to the periosteum near the teeth, but lower down are merged into the mucous membrane of the floor of the mouth. The median line of the tongue is connected with the median line of the gums by a strong fold, known as the **frenum linguæ.** As an abnormal congenital condition this is sometimes connected so near the tip of the tongue as to prevent its protrusion over the teeth, constituting the condition known as **tongue-tied.** This is generally corrected by the muscular efforts of the tongue, which stretch the membrane sufficiently to accommodate its motions.

210. On the **lingual side** in the upper jaw, the gums (Fig. 127) are usually of greater extent and thicker. They cover the entire roof of the mouth, to the conjunction of the hard and soft palate, as a hard dense layer. In the anterior portion, a series of irregular ridges, known as the **rugæ,** radiate from the median line toward both sides, stopping short of the gingivæ. In a large collection of examples almost innumerable forms of these rugæ may be noted.

211. The **gingiva,** or **gingivæ,** is that portion of the gum tissue investing the neck of the tooth crownwise from the attachment of the peridental membrane at the gingival line (Fig. 143). It is also termed the **free margin** of the gum. The length of the gingivæ, from the line of attachment to the neck of the tooth, varies in different teeth in the same mouth,

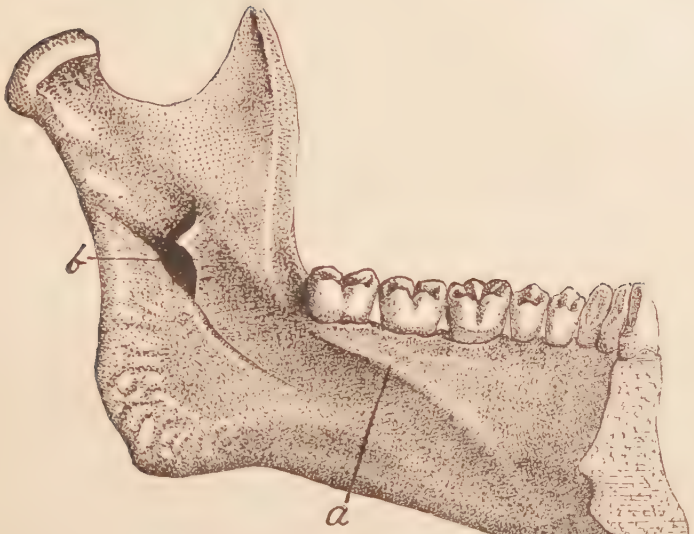

Fig. 142.—Actual size.

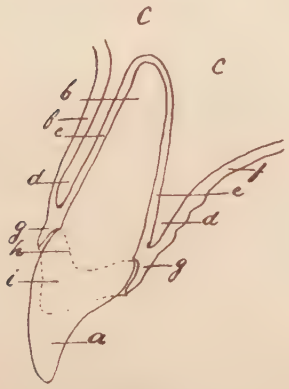

Fig. 143.

Fig. 142 (Par. 202).—Lingual Surface of the Left Half of the Lower Maxilla and Teeth. *a*, Mylohyoid ridge; *b*, inferior dental foramen.

Fig. 143 (Par. 211).—Outlines of a Section of a Central Incisor, cut Lengthwise Labio-Lingually, with its alveolus and appendages showing the relation to the different parts. *a*, Crown of the tooth; *b*, root; *c*, *c*, bone; *d*, *d*, alveolar process; *e*, *e*, peridental membrane; *f*, *f*, gums; *g*, *g*, gingivæ, or free margin of the gums; *h*, gingival line; the portions of the crown included within the dotted lines *i* shows the portion of the proximate surfaces covered by the interproximate gingivæ in normal conditions.

and in different adults, from about one to about four millimeters. It is often much greater in young persons, but the length usually diminishes as age advances. The free margin fits around the neck of the tooth closely, but a thin, flat instrument is easily passed between it and the tooth to the attachment at the gingival line. As the gingival line of the tooth is at the border of the enamel, or at the junction of the enamel and cementum, it follows that the gingivæ inclose the immediate gingival border of the enamel, and cover this part of the crown of the tooth. In young persons, we often see one-half of the length of the crowns of the teeth buried in the gingivæ even after the teeth are regarded as fully in place. As age advances, the gingivæ become shorter, showing more of the crown, and finally recede to very near the gingival line.

212. The **gingivæ** also fill the **inter-proximate spaces** in the form of septa passing between the teeth from labial, or buccal, to lingual. This portion of the gingivæ is much longer than that on the labial and lingual surfaces of the teeth (Figs. 136 and 143). In normal conditions it reaches from the gingival line to the contact-point between the teeth, completely filling the space and preventing accumulations of débris. The form presented by the gingivæ on the labial and buccal surfaces is a series of imperfect semicircles with the concavity toward the occlusal surfaces of the teeth, and with the points of junction of these extending into and filling the inter-proximate spaces (Fig. 141). On the lingual side of the arch, the conditions are much the same, but the points of the gingivæ between the teeth are less prominent (Fig. 27). As age advances and the gingivæ recede toward, or even to the gingival line, the septa of soft tissue fail to fill the inter-proximate spaces. This may induce pathological conditions by affording space for lodgment of débris in pockets, which favors fermentation. A like condition is also induced frequently by a faulty form of proximate contact, or through the flattening of the contact points by wear, which allows food to be forced into the inter-proximate space, and break down the gum septum by its pressure.

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Leaf #92

Allen W. Mundy